With the author's
Compliments.

India in 1887.

Plate 1.

MYSORE BULL.

INDIA IN 1887

AS SEEN BY

ROBERT WALLACE,

PROFESSOR OF AGRICULTURE AND RURAL ECONOMY IN THE UNIVERSITY OF EDINBURGH.

With Plates and other Illustrations.

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TO

LIEUT.-GEN. H.R.H. THE DUKE OF CONNAUGHT,

K.G., K.T., K.P., G.C.S.I., G.C.M.G., G.C.I.E., C.B.,

COMMANDER-IN-CHIEF OF THE BOMBAY ARMY.

PERSONAL AND INTRODUCTORY.

SIX years ago I was appointed Professor of Agriculture at the Royal Agricultural College, Cirencester. During my term of office, which extended to fully three years, until my removal to Edinburgh University, I had in my classes four English civilians and eleven native scholars, who had come from India on the strength of Government scholarships to study English Agriculture.

The application and ability of these men placed them at all times high up in the College honours list. My object in going to India was not altogether confined to a desire to extend my knowledge of the Agriculture of the British Empire, but to learn in an unmistakable manner what fruits the Cirencester College training had borne. I felt that my own reputation as a teacher and the English system of agricultural education were both on trial, and it naturally was a matter of the deepest interest to me to discover how my former pupils had been dealt with by Government, and what facilities had been afforded to them of extending their knowledge of the agricultural practices of their own or their adopted country, and of calling into requisition the results of an English theoretical training.

From my detailed statement it will be gathered how much cause I had to regret the position of all but a few of those in whom I was interested, and how necessary it is for the credit of the teachers who had been involved, that at least a protest should be lodged against the action, or rather want of action, of Government in this matter.

My going was entirely a matter of my own seeking, of my own free will, and for my own ends, although these were largely in the interests of the country. I landed in Bombay on the 10th of May, and left it on my return on the 13th of September. I was thus fully four months in the country. During that time I travelled over 13,000 miles by rail. Those who know what it is to travel in India during the heat of summer will at least give me credit for sincerity of purpose, whatever verdict they may pronounce upon the work which I accomplished. My *route* and most of the numerous centres visited are shown by red lines on Map No. 1. I have intentionally omitted to mark a few places where a halt was made, because in giving what I consider an unbiassed description of my experiences I have had to say in some instances what might, if names were added, wound the feelings of some of my friends, though it is in no way my desire to do so. From Bombay my course was northward—Simla and Lahore being the extremities in a north-west direction. Calcutta and Dárjíling were subsequently reached in the east. The return from the north was by Jabulpur, and Nagpur in the Central Provinces.

Southern India was traversed by way of Madras and the S.I. Railway, which may be said to hug the eastern shore. From Tuticorin, the most southerly point of my journey on the Continent, I passed by steamboat to Colombo. I returned after spending ten days in Ceylon. The course of the northward return journey was more towards the west; but owing to the railway connexion on the western side not being complete, it was necessary to double back from Utakamand and Bangalore to Madras on the way to Dharwar, Poona, and Bombay.[1]

I took occasion, at the first suitable public opportunity after my return, to express the great sense of gratification which I felt at the kindness and courtesy shown to me by European residents in India and by natives whom it was my good fortune to meet. For the above reason I do not now enter into details in this matter, although the lapse of six months has in no way impaired my recollection of the attention shown me.

Those who have not visited India cannot fully comprehend how well and devotedly the duties of our European officers are performed under difficulties of climate, of which in this country we have no conception. The standard of work in matters of administration (the great business of our countrymen in India) is excellent, and the amount performed is quite wonderful. The fabric of the constitution of the Government of India—that institution which dispenses justice and brings peace and prosperity to millions by a mere handful of educated British gentlemen—is one of the most extraordinary that could possibly be imagined. It is quite impossible to detail the reasons for its success, but amongst them all stands out prominently the innate love of justice, which is the birthright of every true-born Britisher. In India we are trusted and respected. I could feel that time is surely deepening the impression in the minds of all thoughtful natives that the future welfare of India is irrevocably

[1] The date of my arrival at each of the main points named I here subjoin :—

Bombay, 10th May.
Simla, 29th May.
Lahore, 8th June.
Calcutta, 14th June.
Dárjfling, 15th June.
Jessor, 24th June.
Nagpur, 20th July.
Madras, 4th August.
Tuticorin, 12th August.
Colombo, 13th August.
Utakamand, 28th August.
Bangalore, 31st August.
Dharwar, 2nd September.
Poona, 6th September.

bound up in the existence of British rule, which is a synonymous term with British freedom.

I have been careful in acknowledging my sources of information where this was possible or expedient, but should any of my many esteemed friends be inadvertently omitted, I hope they will be generous enough to forget and forgive my shortcoming as an oversight. I hope, too, that the consistent omission of the prefix "Mr" will not be thought in any sense to lack courtesy.

I have to apologise to my readers for the condition of a number of the collotype plates representing cattle. The defects are not attributable to Waterlow & Sons, London, who printed them, but to the poor and, in some instances, very imperfect negatives which I supplied. Nearly all of the original photographs were taken by myself in India. [Those borrowed I have acknowledged elsewhere.] I feel that I may claim indulgence on the ground, that five days before I left Edinburgh for India I knew nothing practically of photography,[1] and of the difficulties in India for a beginner, in the shape of moisture and the inconveniences arising from keeping constantly on the move, with the impossibility of being able to find a dark room or even a dark corner. For weeks I had nightly to change my plates (adjusting them altogether by touch) under the folds of my traveller's blanket. To succeed in developing negatives myself was impossible under the circumstances.

I now gratefully acknowledge the valuable assistance in this matter rendered by Baldwin in Cawnpur, Skeen in Colombo, and Hughes in Madras, all of whom were pleased to devote themselves to my assistance.

In determining what plates should appear in my work, I sank the idea of ornament altogether in favour of anything which might serve to elucidate a point which required

[1] My painstaking instructor was the Secretary of the Edinburgh Amateur Photographic Society, W. Forgan, Bristo Place, to whose tuition I am indebted for the ability to bring home anything worthy of being reproduced.

more than a written explanation. The consequence is that a number of plates which appear are, from an artist's point of view, quite inexcusable; still they are, from my own point of view, instructive.

My sojourn in India was a great source of pleasure and gratification to me; and the work of arranging my facts and views for publication has been no less enjoyable and edifying.

The letterpress was practically completed within twelve months from the time I landed in Bombay. My best thanks are due to my friend Hugh Cameron (who acted for Oliver & Boyd, my printers and publishers) for the expedition with which it has been made ready for the public, and for the care displayed in executing the details of the work.

The maps were designed and prepared under the personal superintendence of my friend J. G. Bartholomew, Edinburgh, and the reproduction by lithography of the grasses and crop plants [1] was also executed under his orders to my complete satisfaction.

The execution of the mango coloured plates by Waterston & Sons was equally satisfactory.

In describing the leading crops, I have omitted the growing of opium and cotton, besides many others for which there was no room. The former is a necessary evil, of which the less said the better. About cotton, again, every one knows as much as I should have been able to tell in the space I had at my disposal.

It may be said, and perhaps objected to, that I have devoted a large share of my attention to cattle. There is, however, no subject of greater importance in India than that of cattle, and it is a fact, and one after all not to be wondered at, that, from the peculiar and special nature of the study of it, there are few subjects which are less under-

[1] The originals were borrowed by permission from Duthie and Fuller's *Field and Garden Crops*, and Duthie's *Indigenous Fodder Grasses of the Plains of North-Western India*.

stood by European residents. I think I may safely say that, with the exception of the excellent little book by Dr Shorte, which only refers to a small number of breeds, and is limited in other respects, there is no work which deals in a comprehensive manner with the cattle of India. I do not claim that what I have done has exhausted the subject; but my object will have been gained if my efforts are great enough and successful enough to rouse Government to the knowledge of the importance of it.

Let those who criticise me remember it is just possible that the difference between their own opinion and that expressed by me may arise from their knowledge of certain facts being local. India is a very great country, and there are few officers indeed who possess much knowledge of matters of detail beyond their own immediate neighbourhood. There was nothing that struck me so much in passing from one part to another as this limitation of knowledge, and the likelihood of mistakes arising from it when local facts are stated as generally applicable to the Empire.

Let those who would severely criticise me on account of my short sojourn in the country, look to the discoveries which I record relating to the colour of the skins of cattle[1] and to the influence of early castration, and ask themselves if it is not just possible that those who, with daily opportunities for observation, have yet failed to notice these matters, might not also have overlooked other points which in a greater degree demand special knowledge rather than time for their study. Naturally, many of my outspoken remarks will be assailed; but I leave it to a discerning public to infer that the necessity of bringing the subjects criticised before their notice bears some proportion to the severity of the attacks which may be made upon my rendering of them.

My object in writing an account of my Indian experi-

[1] Professor Huxley, in writing to me on this subject, says, "The fact you mention is of very great interest as showing a hitherto unsuspected relation between colour and climate."

ences, beyond the personal gratification of doing so, is to induce Government to alter its plans as regards an Agriculture Department, and to see that ground which has been lost by inexperienced officers is yet capable of being regained by efforts made in the right direction. One of the most hopeful signs that my desires in the matter of an Agriculture Department in India may be realized is the promise of our home Government to create a Minister of Agriculture and a special Department of Agriculture for Great Britain. Arguing in the abstract—if this country, with all its wealth and the greatness and variety of its resources, requires such an organization, what must India require within her narrow grooves of commercial life, with the evils of an over-crowded population at no great distance, and periodical famines staring her in the face?

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* Taken from Photographs lent by Ozanne.

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* Produced from negatives presented by E. C. Ozanne.

GRASSES.

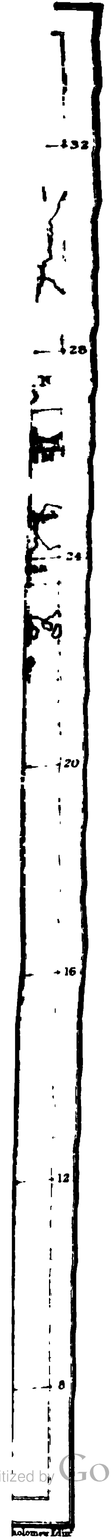
ELECTROTYPES.

MAPS.

ERRATUM.

Page 69, footnote, line 8, *for* "sun-wheat," *read* "sun-wheel."


MAP No I.
NDIA
ACTERISTICS OF LAND SURFACE
Forests
Dried region
Steppes, bush & scrub Land
LHASA
BHUTAN
ASSAM
BENGAL
Darjeeling
Purniah
Bhagalpur
Dacca
Burdwan
Howrah
CALCUTTA
Mouths of the Ganges
Puri
REFERENCE TO LOCALITY
OF BREEDS OF CATTLE.
Deccan 13
Gir 11
Kistna 15
Konkan 14
Malwi 12
Mysore 18
Nellore 17
Red Madras 20
Sind 6
S. Maratha 16
Vadhial 10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INDIA.

CHAPTER I.—CATTLE.

General Description—Objects for which Cattle are kept—Points relating to Form—Colour of Hair—Colour of Skin—Influence of Black Colouring—Temper and Disposition—Horns—Size—Voice—"Escutcheon" or "Milk-Mirror"—Nimburi—Conclusion—Principles of Breeding—Family Resemblance—Force of Inheritance—Constitutional Weakness—Imagination affecting Colour—Crossing and "In-and-in-Breeding"—Atavism—Barrenness.

General Description.

BEFORE describing separately the various breeds of Indian cattle, and to prevent tiresome repetition, the main features and peculiarities common to them as a race may be here advantageously discussed and explained.

The Zebu or humped cattle of India form a distinct species, and are scientifically classed under the title of *Bos Indicus.* They are extinct in the original wild condition, but some have broken away from domestication, and exist in a state of nature in the jungles in parts of Oudh and also of Southern India.

The first, and by far the greatest and most important object for which cattle are reared, is to provide the motive power required by the ryot to cultivate the soil, to raise water for irrigation and minor needs, when wells form the source of water supply, also to convey by cart, or more rarely by back-load or burden, his produce to market. Without bullock labour, which in India occupies a similar position to that of horse labour in this country, the cultivation would be completely paralyzed, as no other common source of motor power is available to accomplish the work done by cattle. Horses are not to be had, and, even if it were possible to secure them, their shoulders could not withstand the jerk of the largest native ploughs, and their feet would poach and injure the land in the wet condition prevalent, especially in the under soil, at the season of active field operations. In England at the present day, on many stiff clay soils bullocks are preferred to horses for field work, on account (among other reasons) of the pressure exerted by their feet being less concentrated, the cloven hoof yielding to the resistance and distributing the weight. Steam-power for ordinary farm purposes is quite as much out of the question as horse labour. Apart altogether from the difficulty of getting skilled workmen, the cost would be too great in a country where the procuring of fuel is already a growing difficulty of considerable magnitude; and again, small holdings with boundaries and divisions which are held as almost sacred, practically preclude the use of steam in all districts except those where land is cultivated in large areas. Cattle, for the reasons given above, are valued for their strength and activity, not on account of flesh-producing capabilities, which form such an important feature in the various breeds of British cattle. Only the low-caste natives and the insignificant number of those of the higher castes who have adopted the European mode of living, eat butcher meat. The wise lawgiver who attached the regulation against eating flesh to the religious ordinances evidently saw not only that the consumption of butcher meat was unsuitable to the climate, but that to insure, especially in famine times, the safety of the breeds of cattle, or, in other words, the power to cultivate the soil after the famine had passed away, it was necessary to forbid altogether the slaughter of animals for any purpose. So much is this regulation respected, that it is not broken even to relieve the most extreme suffering in cases where there is no hope of recovery. Milk and the products from milk are largely consumed in most districts by all classes, and consequently the milking qualities, though these are poor when measured by the British standard, form the second consideration of importance to the keepers of cattle.

POINTS.

In form, or general appearance and substance, Indian cattle are, as a rule, inclined to be leggy and rather "thinly made up." They carry little flesh, and are in this respect strikingly deficient in the **thighs**. In good cattle the **ribs** are well rounded and deep, and the **girth** at the heart is good. This remark is intentionally restricted to good cattle, as with the prevailing carelessness in breeding, even in the best breeds many specimens have flat, short ribs, and are defective in girth measurement. **The hind quarters** are invariably short and drooping, giving, to one accustomed to the full, square, and massive quarters of English breeds, an appearance which would, if occurring in one of our home stocks, be immediately classed as a deformity.

The back line is usually straight from the top of the loins till it approaches the top of the shoulders, where it slightly rises, and is broken abruptly by a fleshy hump, forming a crest or crown, resting on the part corresponding to the withers of a horse. This region in Indian cattle is particularly high, apart altogether from the fact that it is covered by a fleshy prominence.

The hump is a masculine appendage which only comes to full growth when the animal reaches mature age, and is at the same time in good condition. A diminutive hump is also present on the female in accordance with a general law of Nature, so beautifully illustrated in the case of teats, which, while truly feminine as every one, however prejudiced, must admit, are yet present in a rudimentary state on the male. Not only, indeed, are they possessed by a bull, but the position of the teats on the female offspring is so much correlated with the position of the teats of the parent bull, that some breeders are particularly careful in examining how these rudimentary parts are placed before they will admit a bull into their herds. Early castration reduces the size of the hump very materially. This also is in accordance with another natural law, that a male which is emasculated in youth assumes more or less of the form and characters of the female.[1] The size of the hump varies considerably, being very large in many of the larger breeds, and almost absent in the mountain cattle and some of the small inferior local varieties. The shape is frequently most symmetrical, taking the form of a bean set on edge after the lower side has been cut away. The resemblance to a bean does not end in some cases with the contour line, but the hump appears to be formed of two distinct segments, with a depression in a posterior position corresponding to the hollow at the eye of the bean. Other humps appear to consist of one block of flesh. When large, they incline, or, it might be said, fold over to one side like the comb of a black Spanish cock. The flesh of which the hump consists is excellent food, and is considered to be a delicacy. It is eaten fresh, and also corned, and in the latter condition it resembles in appearance, and tastes much like the base or root portion of a well-preserved tinned American ox tongue. Throughout the rather stringy, open-grained, fleshy substance there is an admixture of fat. The hump is erroneously supposed to have something to do with the drawing power of an animal; but its position, which is quite above the part of the neck on which the yoke rests, and the texture of the fleshy matter composing it, put such an idea

[1] This law is the one under which the remarks on the diminution, due to early castration, of the size and strength of the necks of bullocks finds a suitable place.

out of the question. Indirectly, no doubt, a large hump is generally indicative of power, as correlated with the well-developed hump may usually be expected a well-developed and muscular neck. In some places it is a native practice to knead the humps of cattle to increase the size. The same result would be attained, and more in accordance with the course of Nature, if the animals were better fed. It is difficult to see the value of the hump in Indian cattle, unless it is simply an ornamental appendage, or a sort of storehouse of surplus material in the animal economy, which may be drawn from to support life in times of scarcity or starvation.

A sudden droop occurs in the upper neck at the point where it joins on to the trunk. It is in this depression that the yoke is placed by which the bullock is enabled to apply its strength in pulling.

The ears are usually, but not invariably, large and more or less drooping. They seem to hang in a position where it would take little exertion to move them, and when they are in motion they swing forward so as to momentarily cover the eyes, and thereby flap away flies, which are abundant in the hot climate.

A deep dewlap, extending from the chin backwards between the forelegs, is, next to the hump, the most striking characteristic of Indian cattle. It varies in size with the different breeds. In most of these there is correlated with the dewlap a superabundance of skin which hangs down on the posterior portion of the belly. Though not absolutely correct, for convenience I term it the sheath.

The sheath at times assumes large dimensions on the male (it is rudimentary in the female), and in those instances it usually extends forward until it joins on to the dewlap between the forelegs. In other cases it is almost absent even, at times, when the dewlap is well developed.

Colour of Hair.—Indian cattle taken as a race, and represented by pure-bred specimens of the different strains, are what may be termed "whole" coloured in contradistinction to "broken" coloured. By "whole" coloured is not meant that an animal is all of a uniform colour, but that in the change of colour from that of one part to that of another part there is no distinct break or division line — the colours shade or merge into one another. The most common colour is white or very light grey on the body, and the extremities grey of various shades, the two colours blending harmoniously. The bull of mature years is usually darker than the cow or young bull.

Where "broken" or patchy colours appear, they, with few exceptions, indicate cross breeding of more or less recent date. No doubt it is possible in a breed which has been formed by crossing two distinct breeds many years before, to retain the broken colour as a peculiarity of the new breed, but in that case it is well defined, and tends in some respects to become regular, in such features as a white head, white legs, or even white patches on the body of coloured varieties. The broken colours peculiar to cross cattle are irregular and easily recognised by one who is accustomed to watch carefully Nature's freaks in the matter of cattle reproduction. Few of those animals which are termed white are altogether free from black hairs. There is usually a fringe of black or brown round the hoof-heads, and frequently patches on the joints above the pasterns. The tuft of long hair at the point of the tail is rarely white, and there are often dark markings about the ears, with black hoofs, black muzzles, and black eyes as correlatives. The colour of the skin within the ear, though dark, is often of a lighter shade than the body skin; frequently the tint is orange with dark longitudinal patches through it—one being on the same spot that the dark marking occupies in the inside of the ear of Channel Island cattle.

Report,[1] **No. 1112,** of the Madras Government, dated 21st December 1886, attempts to show a connexion between the colour and certain descriptions of food prevailing in the different districts. *Paddy* straw is supposed to produce small, poor cattle of a red, brown, or black colour; *cholum* straw, large powerful animals, good milkers, with white as the prevailing colour; and *ragí* straw, compact and useful beasts, generally grey in colour. Though, with the data available in Madras, there does seem to be something in the theory, yet when applied to India as a whole it utterly breaks down. It is much more likely that in the rice districts, where cattle have to work so much in water, that the dark haired cattle belonging to the aboriginal, and in many respects inferior looking breed, were found to possess the hardy constitution suitable for withstanding the wet; and that consequently the larger light-coloured breeds, that from time to time overran districts of the country to which they were suited, did not there find favour. Again, land which could grow cholum could better afford to bear the cost of the improvement of the cattle by importing than land growing ragí.

Colour of Skins.—Perhaps the most interesting and remarkable peculiarity connected with Indian cattle is the fact that, however white the hair, all but a very small percentage have jet-black skins underneath. Certain breeds, or members of the same, that will be specially mentioned, have skin, horn, and hoof of a brown or dark chocolate hue. Only a mere fraction of one per cent. have white or light-coloured skins like the most of our own home cattle. Although known to the natives, this fact seems to be unrecognised by the European residents, and consequently the immense importance of it has been overlooked. In Gujerat the name *Kolea* is given to an animal with a white skin and white nose, and it is considered to be soft or

[1] The terms "Government Resolution" and "Government Order" are frequently used in place of Report.

weakly. A white muzzle and white skin on the legs and lower part of the body, including the dewlap, may exist without the above consequences, if the major portion of the body skin is dark. The white skins in rare specimens of Indian cattle do not entirely correspond to the skins of the white African negroes mentioned by Joseph Thompson, or to the white skins of certain natives of British India, as these are albinoes, and the white-skinned cattle do not appear to be so. I saw one man, a pure native, a Madrasi, with a skin as white as any European. He was reported to be weakly and even less able to withstand heat than one of ourselves.

There is little doubt but that the black skin has much to do with the ability of Indian cattle to work in the sun without suffering as light-skinned cattle do. In this also will be found the best solution of the question as to whether native cattle can be improved by crossing with English bulls. An animal with a white skin in our own country, during a bright summer becomes tender to the touch, and will shrink from the hand laid on the back; or it even blisters and goes back in condition when exposed to the full force of the sun, under conditions that would not affect darker varieties. One intelligent native pointed out that the difference in the temperature of English and Indian cattle could be recognised by placing one's hand on the skins. Not only is the higher temperature uncomfortable to European cattle at the time, but they, in common with all white-skinned native specimens, are liable to have their skins sunburnt, and, possibly, in the end affected with an eruption corresponding to, if not identical with a form of leprosy. The hair grows in yellowish patches, giving a peculiarly unnatural and rough appearance to the coat. I have seen cases in various stages of development in most of the important breeds. The constitution in such cases is weakened, and the usefulness of the animal is impaired through its inability to meet the exigencies of the climate.

The skins of nearly all the lower animals—sheep, pigs, buffaloes, and horses—under domestication in India are black or dark. It is true that certain breeds of sheep have white wool on their bodies, and most naturally white skin under it, but the head, or most exposed part (covered only with short hair), is frequently black. Sheep, especially the good white-coated varieties in India, are much better protected than other animals from the direct influence of the sun by the wool and the cushion of air which it retains within its interstices, and are thus more independent of the influence of colour. It would appear that the presence of white hair on a black skin is an advantage, being widely prevalent on Arab horses and also on many of the different breeds of cattle. It has always been a marvel that the white skin, which on account of its colour does not absorb heat so quickly as a black skin, should not prevail in the human species within the Tropics; and it becomes even more wonderful now, when it begins to dawn upon us, that the skins of the lower animals follow the same great law of Nature, whatever that law may be.

It would be assuming too much to take for granted that in the colour lay the only advantage in the matter of power to resist the sun's influence, which the skins of animals in India possess over the skins of animals from more temperate climates.[1] The known difference of quality of surface,

[1] Various theories exist as to the influence of colour. *Nature*, August 1884, in a paper "Why Tropical Man is Black," says, "Nature having learned in ages past that pigment placed behind a transparent nerve will exalt its vibrations to the highest pitch, now proceeds upon the converse reasoning, and placing the pigment in front of the enlarged nerve reduces its vibrations by so much as the interrupted light would have excited, a quantity which, though apparently trifling, would, when multiplied by the whole area of body-surface, represent a total of nervous action that if continued would soon exhaust the individual and degrade the species." In *Nature*, November 1884, under "The Blackness of Tropical Man," it is said, "In addition to the greater dissipation of heat by black than by white skins, it is to be inferred that the real protection resulting from pigmentary blackness in the human skin consists in there being a few of the invisible solar rays of the spectrum in tropical light injurious to man, which never-

thickness, and texture have unquestionably their influence, but it must be left to experiment to determine the relative position of importance occupied by each. I am indebted to Professor Huxley for making me fully aware of the importance of these qualities, which, as he remarks, make the question "immensely complicated." Yet it seems open to us, on theoretical grounds, with the data at our disposal, to look at the direction in which certain influences act, although we may not be able perfectly to point out the limits of their action.

The Influence of black colouring.[1]—"It would seem at first sight that the black skin should rather be a disadvantage than otherwise; but in the reality it is not so. The black colour of the skin causes it to absorb more heat than a white skin, but while it is doing so, at the same time and for the same reason it is giving off more heat—its absorbing power and also its radiating power being greater. Therefore, when the sun's rays impinge upon the skin, the heat is rapidly absorbed; but, as the rate of absorption of heat is greater than the rate of radiation, unless the temperature of the skin were lowered by some other influence, the whole surface of the body would become extremely hot.

"To complete the explanation, we must here take into consideration what is known of black-skinned men. Any one who has been in India can see that natives, although they drink water freely, do not appear to perspire so copiously as Europeans, but this is simply because more of the perspiration comes from them in the form of vapour, and less is seen to stand like dew-drops on the surface of the skin. In the evaporation of the moisture exuding from the skin, we have a demand for heat far greater than an ordinary observer might imagine; and by it all the surplus

theless possesses unusual penetrative energy . . . . but which are intercepted by the contents of the epidermic pigment cells in the African and in the Hindu.

[1] From a paper communicated by the author to the Royal Society of Edinburgh on 5th Dec. 1887.

heat which the black skin absorbs over and above what it gives off by radiation can be disposed of. It is a fact which few realize, that the amount of water is small indeed which, by being evaporated, could transform into its latent condition all the heat derived from the warming influences of the sun in the hottest climates."

In a communication, which I have received since the above was written, from Professor von Helmholtz, Berlin, he says, "I do not know any physical explanation of it,"—the advantage of the presence of black skin. "An analogous fact, certainly, is what I have often seen in Switzerland, that light-coloured men, who do not become brown in the sun, get blistered and become covered with eruptions by the reflection of the sun from the snow-fields; while those who become brown bear it much better. The black pigment generally lies in the deeper epithelial layers. Perhaps the nerve ends or other parts of the living tissue are sensitive to the deep piercing rays of the sun, and the violet and ultraviolet rays, which are usually most powerful in all chemical actions, are kept off by the brown pigment. It is known, also, that in frogs and chameleons the shifting black pigment moves to the surface as if the outer layers of the tissues had to be protected."—*Translated.*

While every one must admit that the above remarks are conclusive of the view expressed by Professor Huxley of the extremely complicated nature of a full solution of this question, yet I cannot see that they are incompatible with my own theory, which referred to the part played by absorption, radiation, and evaporation.[1]

Temper and Disposition.—Indian cattle are very im-

[1] Darwin in *Animals and Plants under Domestication*, chap. xxi., says,—"Light-coloured animals suffer most from insects; in Thuringia the inhabitants do not like grey, white, or pale cattle, because they are much more troubled by various kinds of flies than the brown, red, or black cattle." "In the West Indies it is said that 'the only horned cattle fit for work are those which have a good deal of black in them. The white are terribly tormented by the insects, and they are weak and sluggish in proportion to the amount of white.'"

patient in the presence of strangers, more especially Europeans, while perfectly docile and amenable to treatment with their everyday native attendants. They show much displeasure at the presence of strangers if at close quarters, and would usually horn or kick furiously on the slightest provocation. Some breeds are much worse than others in this respect, although the remarks are generally applicable.

The horns of the different breeds are exceedingly variable in shape and size, and also in the directions in which they incline after leaving the frontal bone.

In animals bred under the hand of Nature, there is a strong tendency to uniformity of type, not only in the colour, but also in the shape of horn, and I might fitly add, in general characteristics. The greater variety and sports among domestic cattle generally show the results of human effort to attain certain ends. In even the most constant types of breeds under domestication, we do not find the same similarity that Nature shows. The horns of the bison and the various antelopes and wild sheep do not vary greatly within the bounds of each species. In India, among the cattle, I repeatedly came upon loose

Although nothing is said of the colour of skin, the remarks evidently refer to white-haired animals possessing white skins under the white coat, and most probably belonging to the genus *Bos taurus*. Again, "white pigs suffer from scorching by the sun." Speaking of cattle, he says,—"Cases have been published of cutaneous diseases with much constitutional disturbance (in one instance after exposure to a hot sun), affecting every single point which bore a white hair, but completely passing over other parts of the body. Similar cases have been observed in horses." I have no doubt but that had Darwin been the observer of the details of those cases he records, he would have discovered that the areas affected, though very closely corresponding to the areas coated with white hair, were yet more nearly identical with the areas of white skin. It should be understood that the areas of white hair and of white skin do not exactly correspond in our own cattle. Some British cattle that are mostly white under the white hair have black or brown patches or spots away from coloured hair of any kind, and not noticeable until the hair is turned up. Again, the darker skin prevailing under dark spots, extends often an inch or more under the surrounding white hair. Only a small percentage of cows that are practically white-haired have the black skin predominating.

dangling horns with no bony attachment to the skull. These correspond to sports that at times appear in our own home breeds of polled cattle. As they were not noticed in the more pugilistic breeds, such as the Mysores, but only in those possessing domesticated dispositions, it would almost lead one to believe that this is the first step towards the complete obliteration of a member which is becoming obsolete. This view is supported by the testimony of observers who have visited the Soudan. They report that loose horns are quite common there, and that the dispositions of the cattle are extremely mild.[1] We start with the assumption that all cattle in the wild state possessed horns for offensive and defensive purposes.

The size of the animal is governed mainly, as is the case in all parts of the world, by the amount and quality of available food. Various **other characters**, some seen and some unseen, are dependent upon local conditions—for example, cattle bred on rich, deep land have soft and tender feet, while cattle reared for generations on hard soils of a poorer stamp have usually flinty and durable feet of handsome form and moderate dimensions.

In voice Indian cattle differ as much from the European races as in any other particular. In place of the ringing bellow and whoop of the English bull, in which both lungs and throat play an important part, giving bellow after bellow until the distant rocks and woods echo and re-echo, and, if possible, clarify and accentuate the sound, there is but a hoarse guttural grunt or half cough thrown down to the earth. In the female this form of bovine utterance precludes the smallest possibility of rousing those feelings of sentiment which, in Scottish and English minstrelsy, are associated with the lowing of a cow. The peculiar sound rather gives one the impression at first that there is something wrong with the animal.

[1] For confirmation of this fact from personal experience I am indebted to J. Baird of Knoydart.

The "Escutcheon" or "milk-mirror" theory of **M. Guenon** asserts that there is a correlation between the amount of milk given by a cow and the form and size of the irregularly-shaped area of skin situated in the posterior part of the body, spreading from a little below the setting on of the tail, covering the back parts of the udder of the cow, and extending more or less on to the thighs.

The area in question is recognised by the hairs covering it being swirled or turned in an opposite direction to that of the hairs on the skin close to it. If there is much truth in the theory as regards Indian cattle, it will be necessary, on arriving at the facts, to so far alter the rules regarding the prescribed shape and size of escutcheon laid down as indicative of certain milking qualities, because in India, of many specimens examined, a large number had the peculiar markings wide above, and tapering as they extended downwards, being very different from the escutcheons of British cows, which are broad in their lower dimensions, and taper as they ascend. At present natives look for a skin which is soft to the touch as an indication of the presence of good milking qualities in a cow.

The Nimburi is the name given in Bombay to a little bony prominence which rises from the crest of the frontal bone midway between the horns, see Plate XI. (*b*). In some breeds, as in the *Malwi*, it is generally absent; in others it is expected to be present, as in the *Dangi*[1] near to Igatpuri; while in most breeds its presence or absence is irregular, and little notice is taken of it.

Conclusion.—Before endeavouring to describe in detail the various breeds of Indian cattle, it is necessary, as a sort of key to many of my assumptions, to draw attention to the general laws of breeding which are applicable to the subject. I do so as follows, by quoting from my own work on "The Farm Live Stock of Great Britain."

[1] The narrow belt of hilly jungle country with heavy rainfall running along the eastern slopes of the Western Ghats is called the Dangs.

PRINCIPLES OF BREEDING.

The strong family resemblance which is seen both in the human species and amongst animals related to each other, is a direct consequence of the existence of the first law of breeding, which is not constant in everything, but always holds good as regards general characteristics, viz., that "like begets like." Other laws are in operation at the same time; consequently, when we come within the immediate sphere of their action, this and various other laws become modified by the influence of surrounding conditions. The influence of a parent, as such, in his or her first function, is not always exerted under exactly the same conditions, and consequently we have differences between individuals, alike in many respects, which distinguish them from one another.

To the uneducated eye, every member of a herd of Galloway cattle, or of a flock of Southdown ewes, looks exactly like its neighbour, and a townsman stares when he is told that some shepherds know individually every member of a flock of sheep amounting to perhaps 200 or 300.

The force of inheritance is strongest in old and well-established pure breeds, but even among the best a very inferior animal (as the American "skellywag" among cattle) may appear at times. This degenerate specimen should never be allowed to breed. It is by getting rid of all such inferior or even moderately good animals that our breeds are improved. Weeding by the hand of the breeder, or artificial selection, acts much in the same way among domesticated animals as the law of the survival of the fittest does among wild ones. A well bred, though plain looking bull, if he has no deformity or no very objectionable points, usually breeds much better stock than a more handsome one without a go d pedigree. In selecting, it is much more important to have the sires than the females good, because, besides the greater potency of the male, one bad one may affect a large number of offspring, whereas an inferior female only has to do with her own young. This becomes a most important matter when taken in connexion with the fact, that "the influence of the first male by which a female produces young may be seen in her future offspring by different sires." Everyone knows, that should his English terrier bitch get lined for the first time by a Dandie Dinmont, she will years after throw puppies with some of the Dandie characters. The same holds, though perhaps not to such a marked degree, with the larger animals. For this, and the other reasons which induce people to go in for good stock rather than bad, a mongrel bull should never be put to good cows. The best bred animals are often far from perfect in some points. It is most important if ever a bull (or sire of any breed) with a special defect has been used, say a hollow or weakness behind the shoulder, that all succeeding sires should be specially strong in the particular point, whatever it was, else there might in time be a general defect established in the whole race of descendants. Males are more variable than females. For instance, say in a mountain breed of sheep, it is much more easy to select a large number of ewe lambs than of ram lambs fit to be exhibited in a show-yard.

Animals with constitutional weaknesses amounting to unsoundness should not be used for breeding. Defects resulting from accidental injuries are sometimes transmitted to the young, and may, or may not, be hurtful. The tendency to bony exostoses on the leg bones of a horse, from the parents contracting these through hard work on the road, would be a case of the first kind. The following is an illustration of the second: A black spaniel bitch, belonging to Commander Harrison, R.N., had the tip of her tail caught in a door; white hairs grew from the injured part, and she afterwards bore various puppies with white tipped tails, never having done so before.

Imagination sometimes comes into play in breeding, especially with regard to colour. The colour of an object at which an animal looks while conceiving sometimes governs the colour of the young. A perfectly pure bred Ayrshire cow at Auchenbrack, Dumfriesshire, gave birth to a dark dun calf, the same colour as her mate, which was a cross from a Channel Island's cow. The peculiar dun was not an Ayrshire colour. It is recorded of M'Combie, of Tillyfour, that he succeeded in preventing his black polled Anguses from breeding red calves by putting up a high black fence round the field, thus preventing them seeing the red cattle of his neighbours. A well-lighted byre, with whitewashed walls, is supposed to make calves lighter. How far the colour of the sire is transmitted to his offspring by inheritance, and how far by the imagination of the female, we do not pretend to know, but are inclined to believe that inheritance has most sway, especially in some crosses between two distinct breeds.

Certain colours can be, as a rule, depended upon to produce other and altogether different colours in the young; for instance, a black Galloway cow and a pure white shorthorn bull almost constantly throw a very dark-roan or blue-grey. A light-roan might give the same result; but a dark-roan or red bull will get either black or red colours, which are not so much desired. In the same way, when Ayrshire cows are crossed with a shorthorn, a light-coloured bull throws more of the shorthorn character into the colours of the calves, which bring better prices, as they are usually wanted for fattening purposes.

Crossing and "In-and-in-Breeding."

Crossing families not related to each other usually gives increase of vigour and larger size, though sometimes the distance between the characters is so great that the result is much like a cross between two distinct breeds. For this reason some object strongly to mixing up the blood of Booth and of Bates shorthorns.

Too close "in-and-in-breeding," or pairing of animals related to each other, causes great loss of constitutional vigour, loss of size and fertility, and sometimes malformation—as a pig at Twiglees, Lockerbie, which had a part of the backbone wanting. Pigs show the bad effects sooner than any other farm animals. Darwin points out that this is perhaps on account of their comparatively solitary habits. Gregarious animals do not suffer so much; they have been more accustomed to it, and Nature has accommodated herself to the circumstances.

Shorthorns are not so much the worse for in-breeding as most other stock. Their distinct type has been stamped upon them by judicious in-breeding. This stamping of family characters or types is the only advantage of in-and-in-breeding, and cannot be dispensed with in the formation of new breeds or the improvement of old ones.

Crosses between two distinct breeds mated the proper way make the best fattening animals. The sire, in virtue of his greater potency, should be of the more improved breed; for example, the shorthorn bull breeds well with cows of milking breeds, or slow maturing sorts, as Kerry, West Highland, Ayrshire, or Galloway. Crossing the reverse way is a failure. Of late years, since the Angus breed has been so much improved, farmers cross shorthorn cows successfully with Angus bulls.

In farm stock it is considered that the male gives the external form, the female more of the vital and internal organs. This does not belie the fact that a calf has often a very strong likeness to its mother.

With a thoroughbred horse on a mare of another breed, the result has generally a symmetrical form. The other way, the cross is often stronger and more useful, but plain, usually about the hind quarters and head.

Sheep come under the same rule. Any of the improved varieties of Leicesters or Downs may be used with advantage, under certain conditions, to put to the various mountain breeds.

The first cross between two breeds is intermediate between them; but after the first cross, it cannot be calculated how the tendency may run.

The first cross is the strongest. After-crosses get smaller and weaker, and all the more so the longer crossing is continued. This necessitates going back now and then to one of the pure breeds for a sire to infuse new vigour. This explains the success of crossing mongrel cows with a pure shorthorn bull.

Atavism, or "throwing back," or "reversion," is the reacquiring by an animal of some character which the immediate parents had not, but which existed in its ancestors.

Two classes—(1.) In Purebred Stock. (2.) In Cross Stock.

1st, Reversion in Pure Breeds.—The aboriginal species of domestic cattle and sheep no doubt had horns for defence and attack; now many are without them. Sometimes, however, a ram of a polled breed, as the Cheviot, has small horns. In cattle this is also the case, as imperfectly formed horns at times appear in both Red Polls and Galloways.

Sheep, for their better protection when wild, were originally brown or dingy black. Now and then in the best flocks reversion is shown by the appearance of a black sheep; and so frequently is this correlated with poor quality, that it has become proverbial to describe the unfortunate member of a family as the "black sheep."

2nd, Reversion in Cross Animals.—This is much more common. When two distinct breeds are crossed, the offspring has a strong tendency to revert to one of the pure forms, or rather to an inferior ancestor of one of them; and this lasts for generations. The young often take the colour of one parent, and in time change it for the other. The calf from a black cow by a red bull is often born red, becoming black afterwards; and the mouse-coloured foal of a chestnut mare may become chestnut.

"**The act of crossing** in itself gives an impulse towards reversion," as seen by characters appearing in the young that had not been seen in either pure breed for generations. Calves are sometimes produced white with dark ears, like the ancient wild cattle, by a red shorthorn bull on West Highland cows.

Cross-breds are often wilder than pure-breds. This is noticed particularly in cattle and sheep. Cross sheep are not so easily fenced, and a dairy of cross cows is much more difficult to train to stand for milking in the field than pure shorthorns.

Domestication increases the fertility of animals, if properly bred and not overfed. Being in an improving condition at the time of conception increases the number of twins. In a flock of ewes the largest number of twins is got the first few days the ram is out. The first young of most animals run slightly more to the female than to the male side.

Barrenness or uncertainty may be caused by, *1st*, Over-feeding in the case of either sex, thus loading the reproductive organs with fat.

The remedy is judicious starving, or working, in the case of cattle or horses. Some foods cause uncertainty in breeding more readily than others. Sugar, molasses, and linseed are as bad as any, but are nevertheless often used to get beasts up for show or sale, because they give a smooth and glossy skin, as well as lay on fat. These foods would not do damage if given in moderation with hay or straw, but it is when given in addition to a full feed of other concentrated food that they do harm. Foods for breeders should be particularly rich in phosphates, and should have more albuminoids to fat-formers than in the case of feeding animals; such foods are—beans, peas, lentils, gram, etc. Fat animals do not come often in season, and consequently settle better and feed faster.

2nd, Too low condition, especially if combined with exposure to cold and wet, as with cattle wintered outside on poor food, or heavy milking cows sucked down by a large calf, or perhaps by two calves. This occurs most frequently when calves run constantly with their mothers.

3rd, Constitutional weakness from in-breeding.

4th, Being a free-martin or dumb-martin, that is, a heifer born one of a pair of twins, the other being a bull. In this case the external as well as the internal organs of generation are imperfectly formed and contracted. There is usually also a more or less masculine appearance about the head. Exceptions to this rule have been recorded, particularly among West Highland cattle.

Sheep or horses do not answer to this rule. Twins from a mare are very rarely seen,—because when they occur they are usually born too soon, or die if they do come to full time.

CHAPTER II.—CHARACTERISTICS OF BREEDS OF CATTLE.

Mysore Cattle — Their Origin — Names — Original Type — Distinguishing Features—As Milkers—Plates I., II., III., and IV.—Early History of the Amrit Mahal Breed at Hunsur—Early Castration—History (continued) —Early Castration—Restoration of the Herd—Recent History—Leading Strains of Mysore Blood—Village Cattle—Punganur Variety.

MYSORE CATTLE.[1]

Plates I., II., III., IV., V.

ORIGIN.—The members of this breed are divided into many branches, each branch being noted for some particular character or characters, while, at the same time, all retain a certain unmistakable similarity in points and qualities that distinctly mark them out among other Indian or foreign cattle. There is a tradition among the herdsmen that the original breed, which brought the characters above referred to, was imported from the north-west, and it is supposed that in those early days, in addition to the qualities for which they are now valued, they possessed good milking powers, and were kept and reared partly on this account.

Names.—The breed is known by sundry generic names, used by people at a distance, which, along with the specific names of the different local strains of blood, lead to no little confusion. *Hunam*, or South breed, is the name

[1] For much information regarding the ancient history of this breed, I am indebted to the able and experienced officer (Col. Hay) at the time, September 1887, in charge of the Government Cattle Farm, Mysore.

Plate 2

MYSORE COW AND CALF.

given by people living to the north. It is a common practice in India to give in the name an indication of the direction from which imported cattle come. The name *Khilari* signifies that they are reared and kept in herds—from *Khilar*, a herd—in contradistinction to cattle bred in smaller numbers and in closer and more intimate communication with man, as is universally the case with Indian village cattle.

Local names, as of places or districts, are usually applied to Mysore cattle of those districts, to distinguish them from other varieties of the breed.

The original type of animal first imported many generations ago is most probably not now directly or fully represented by any of its descendants. The divergencies from the original stock and the characters peculiar to local breeds would be gradually influenced in two ways. First, as the Mysore blood spread over the country it would to a greater or less degree be "stained" by infusion of local blood, and, though with the greater potency which is usually combined with fine quality resulting from careful breeding, it retained the main features, variation to some extent would become inevitable; and, second, the influences of varying surrounding conditions, continued through generations, mould and alter the characters of all classes of animals, not so much by means of the law of the survival of the fittest, as this hardly comes into play except in cases of extremity, such as famine, but through a natural tendency to constitutional adaptation, without necessitating the killing off or obliteration of any. For example, in some districts cattle almost invariably have hard flinty feet; in others the feet are soft and easily injured. Again, some soils produce animals with large bones and massive frames, other soils produce small bones. In the matter of colour, I have no doubt the soil, in some cases, has had an influence, but in the particular instance of the Mysores of the western districts, the dark colour is much more likely to be the result of the "stain" left by the aboriginal cattle, which seem to have been much darker in the colour of hair than those of the present time.[1]

The variety of the Mysore cattle which is perhaps the handsomest, best known, and most largely represented, is the *Amrit Mahal* breed, the chief centre of which is the Hunsur grazing farm of the Madras Government.

The distinguishing features may be gathered from the following description:—The *head* is long and tapering towards the *muzzle*, which is generally black. The *forehead* bulges out beyond the line of the elongated nose like the foreheads of many young calves of our home breeds.

The *horns* are set well back on the crest of the frontal bone. They spring close together like the horns of a goat, then diverge, and incline backwards each in a straight line for fully half the length, when with a gentle and graceful curve they bend upwards and usually slightly inwards towards their terminations, which are black tipped and exceedingly sharp. At times when the head is down, as when feeding, the horns touch or almost touch the neck in front of the hump. They thicken gradually as the head is approached, and are very strong near the base, which seems to extend, apparently to give strength, down the forehead between the eyes, as a distinct ridge on each side, thus forming a perpendicular groove or depression in the centre of the forehead. Plates I., II., and III. represent horns as they ought to be. Plate IV. (*a* and *b*) shows the largest horns which I saw in the Mysore breed. The ones marked *b* measured 3½ feet in length, and 16 inches in girth at a distance of 6 inches from the junction

[1] Cubbon says, 2nd Sept. 1818, "Coloured cattle are considered inferior to the white or grey in energy and perseverance, though they are rather superior in size." The latter remark only refers to this special case, and is the reverse of the usual rule.

with the head. Horns of these dimensions are altogether abnormal in this breed. The animal which grew them was kept because of the extraordinary horns. Though it measured 53 inches in height, it was in other respects a perfect abortion, and quite a curiosity on account of its accumulated points of deformity.

The *eyes* are quick, but not large or prominent; they are usually black, but at times (and this generally in superior cattle) they have a red or bloodshot look about them. The peculiar setting on of the horns with the skin and hair covering them up a little way above the actual root makes the head appear longer than it really is.

The *ears* are yellow within, neat and short for cattle of the size, and taper rapidly from a good breadth to a sharp point; they project at about right angles from the cheek.

The *tail* is nicely formed, and tapers like a whip-lash to the black terminal tuft of hair.

The *hump* and *dewlap* are both well developed.

The *back-line* is straight from the shoulder to the loins, where it droops, and usually more rapidly than in the case of the bull shown in Plate I.

The *hoofs* are small, hard, and well formed.

The *ribs* are well rounded and deep, yet the belly is not too large to interfere with active work.

The *shoulders* are remarkably neat, and the *bones* of the leg fine, flat, clean, and racehorse-like. On account of the fine bones, the muscular *forearm* does not appear massive in proportion to its actual strength.

The breed, as a whole, occupies among cattle a position for *form*, *temper*, and *endurance*, strongly analogous to that of the thoroughbred horse among horses. The animals representing it are light in *build*, and their greatest defect for army purposes is their moderate size. Bullocks average about 47 inches, while the selected specimens suitable to yoke into heavy guns stand 50 inches to 53 inches, measured behind the hump.

In *disposition* they are extremely fierce. They particularly dislike strangers, and would attack them if untied. They are the worst conducted cattle in India as regards treatment of one another, often savagely horning their neighbours, and inflicting serious wounds. The tips of the horns are frequently sawn off to reduce the chances of injury.—See the head marked (*d*) in Plate IV.

As *workers* the bullocks are excellent, but from their hardiness and fiery temper, with which are combined spirit, strength, and activity, they are perhaps better suited for draught work on the road than as agricultural cattle. Nevertheless, it is astonishing how tractable they are with the natives who work them and are known to them. In working land a slower and steadier pace is more serviceable. A good pair of bullocks will cost Rs. 300. Many at this price, and down to Rs. 150 a pair, are sent to all parts of Southern India. When kept in good working condition they can trot for several days together, averaging 30 miles to 35 miles daily. They not uncommonly continue to work for 20 years.

The natural *colour* of the hair of the cow is white, and that of the bull grey. Early castration of bulls makes them decidedly lighter in colour; they then lose the characteristic colour, more or less, in common with other masculine characters. Marled or *broken colours* I regard as a strong proof that cross breeding has been practised. I decidedly thought that broken colours appeared most frequently in inferior specimens, though the rule was not without its exceptions, as may be seen by referring to Plate III. This inferiority still further convinced me that broken colours were unnatural to the pure breed.

Black *hoofs* and black *muzzles* greatly predominated, yet there were more instances of white or flesh-coloured noses and light hoofs than in any other breed.[1] I noticed the fact more particularly in Southern India. The white nose,

[1] This refers to Mysore cattle as a whole.

Plate 3.

MYSORE TROTTING CATTLE

eyelids, and feet were at times accompanied by a white or light skin, but this was the exception rather than the rule. Those with white noses and, for the most part, black skins, though they do not suffer from the direct influence of the sun, yet are said to be softer in constitution.

As milkers, the cows are notorious for their poor yield. It is a common tendency in all breeds for the milking qualities to degenerate when calves suck in a state of nature, as when cattle go in herds.

Plate I. shows a beautiful specimen of a five-year old bull, "full-mouthed," and perfectly developed in every respect; and **Plate II.** of a cow, with her calf two days old, equally representative of the breed. These were selected from a fine lot of cattle which had been brought from Hunsur to the Government farm in Khandesh, with the commendable object of starting a small well-bred herd. The bull cost about Rs. 100. He measured 48 inches high behind the hump, and 5½ inches more with the hump; his horns were 1 foot 8 inches long and 9½ inches in girth at the base.

Plate III. represents two *bandy* (carriage) cattle in the good condition in which such beasts are kept by European officers and wealthy natives. The well-developed masculine characters, including their massive necks, show that they have not been weakened by early castration.

Plate IV. shows the thin necks and the irregularity in form of horn resulting from early castration.

History of the Breed.

The early history of the "*Amrit Mahal*"[1] cattle seems to say, picking up the threads of the story of the Mysore

[1] "*Amrit Mahal*" comes from "*Amruth*," which at first signified nectar, and more recently milk; and "*Mahal*," a palace, and might, in its early days, have been the breed kept to supply the rulers with milk, as well as with bullocks for purposes of war. Some authorities say this origin is extremely doubtful.

breed at page 22, that the strain was produced by crossing a number of the best varieties collected from the districts of Mysore. Prominent among them were the *Hallikar*, *Hegglewady*, and *Chittaldrug*, etc.;[1] and one tradition referring to the time of Hyder Ali, Sultan of Mysore, adds, "a nameless breed," but no doubt of the Mysore type, brought from the Trichinopoli district. Though, perhaps, altered in character from time to time, the strain is supposed to have existed since the early years of the Mysore kingdom.

The breed seems to have come to its greatest perfection under the native rulers,[2] whose system of management, we infer, must, in some respects, have been more perfect, though it is supposed to have been on the same pattern as that employed in more recent times.

For military purposes the breed has always been famous, but especially so during the early period of its written history.[3]

[1] A Hunsur report, dated 31st Dec. 1849, says, regarding this matter, "The *Chittaldrug* is noted for speed and activity; the *Hegglewady* and *Hallikar* for spirit and endurance; the *Ajjumpur* for symmetry of form; and the *Mahvally* for bulk and strength." "The absurd legend current amongst the herdsmen regarding the origin of the best strain—the *Hallikars*—is that Hyder Ali brought cows of the small *Brahminy* caste from the south, and got them crossed by the big black bucks of the antelope, and produced the *Hallikar* breed." No doubt this story originated through a "small spot below the eye being common to the antelope and the *Hallikar* cattle."

[2] This is stated merely as a matter of opinion, as the difficulty of comparison is admittedly great.

[3] Sir Mark Cubbon, in enumerating the feats of the A. M. cattle, says, "They enabled Hyder Ali to march 100 miles in two days and a half, to the relief of Chillumbrum, and after every defeat to draw off his guns in the face of his enemies; they enabled Tippoo Sultan to cross the peninsula in one month for the recovery of Bednore, and to march 63 miles in two days before General Medowes; they, in later times, enabled Major-General Pritzer to march 346 miles in twenty-five days in pursuit of the Peshwah; and they enabled Major-General Campbell, after the failure of his Bengal Equipments, to advance upon Ava and bring the war to a favourable termination. It was also these bullocks which enabled the Duke of Wellington to execute these movements of unexampled rapidity which are the admiration of every military man."

Plate 4.

(a) HEADS OF MYSORE BULLOCKS.

(b) HEADS OF MYSORE BULLOCKS.

In 1800 the whole of the cattle were taken over by the British,[1] but the management of the breeding establishment was left to the Raja of Mysore, on condition that bullocks were supplied for the Government services.

This arrangement lasted only for thirteen years, and, in 1813, the whole breeding stock, amounting to 10,914 in number, were taken back by the Mysore Government, because the bullocks had degenerated in an almost incredible manner, and cost in outlays the large sum of Rs. 69 each. It would be interesting to learn if early castration was instituted during this period, as it appears quite impossible, unless some outside impetus was given to the tendency, that such splendid cattle could naturally degenerate in so short a time that the remark could be made regarding them—"Inferior and increasing in degeneracy, as they notoriously were." If a short supply of food by overstocking had been the cause, the numbers would have decreased, but this did not occur.

The establishment remained under Government management till 1860. From a memorandum by Captain Harvey, dated 1813, it may be seen that **early castration was practised.** "The whole of the male calves, with the exception of such as are intended for bulls, are to be castrated before they are one and a half year old."[2]

During the three years from 1813 to 1816 the numbers increased to 14,400, and difficulties arose regarding the increased amount of pasture necessary, but these were got over by liberal concessions from the Raja of Mysore. The cattle also reaped much advantage from the Raja of Coorg

[1] The cattle belonging to Tippoo Sultan were delivered up to General Lord Harris after the capture of Seringapatam.

[2] Although this rule is yet in force, Col. Hay tells me that for some years a considerable "number of young cattle often remain uncastrated till three years old, that a selection may be made from them for bulls." He says further, that "some of the buyers of our grey cattle in the Southern Maratha country keep them uncastrated for a good while, and feed them up highly, with the object of producing size and weight in front for heavy draught."

permitting them to spread over his frontier into his good pastures during the hot months, when the home pastures were at their worst. The shade and moisture of the jungles of the South-west afford advantages superior to the other parts of the grazing lands of Mysore during the hot weather, from May till September. It is stated that "the growth was supposed to be promoted by early castration." Though there is no distinct statement that castration was delayed in the old native system of management till near to the time the animals reached their full growth, in accordance with the present all but universal practice among natives, yet by reading between the lines of the last quotation, one is led to believe that early castration, which was made imperative by the above quoted Government resolution, was, at least as regards the whole of the cattle, a new thing. Notice would hardly have been taken of the fancied improvement brought about by early castration, unless it had been to defend a new system. As regards the actual fact of the improvement of growth from this cause, I put no confidence in the accuracy of the statement.[1] If it had been so then, the same rule would hold good still, and we shall see later on if that is so. Again, unless there had been some delay in castration, we should hardly expect to find such a definite and peremptory rule regarding it.

Further, it is recorded that castration was practised in the cold weather in November; that the bullocks were taken from their mothers at five months old, and from the herd after four years old; that they "arrive at their full strength at seven, and are past their vigour at twelve; working well till fourteen or fifteen, decline rapidly, and die about eighteen years old."

Ten years after the Government had taken it over, the herd was well-nigh doubled in numbers.

[1] There were sundry nefarious practices (such as the removal of good calves) put a stop to about this time, which might well account for improvements in certain directions.

In 1836, right to some of the good grazings of the cattle establishment were withdrawn ; and, in 1838, some experiments were tried with regard to the management, but had within two years to be given up as failures, and the old system reverted to.

In the year 1840 the Raja's *Amrit Mahal* herd and grazings were joined to those of the British Government, and the whole "transferred to the care of the officers of the Mysore Commission." This arrangement held till 1860, when, by Government orders, the establishment was broken up and the cattle dispersed. This was an unfortunate interference on the part of Government in a matter of which no one but a specialist was qualified to judge. The resulting injuries are still felt in the country.

Degeneration of the Breed.—There are no detailed records of complaints made against the quality of the bullocks during the early part of the period subsequent to 1813. Soon after 1848, however, many of the young cattle intended for the artillery were rejected by the committee appointed to inspect them, as being "deficient in substance and unfit for the work." An elaborate defence was prepared by Captain W. H. Budd, dated Hunsur, 31st December 1849, showing that the bullocks had not degenerated within recent years. No attempt was made to prove that the cattle were as useful as they had been under the old original native management, consequently it must be inferred that that position was not tenable.

Early Castration.—The only point of material difference between the management adopted under European direction as compared with native direction is that of *early castration ;* and in my opinion this alone, carried out in direct opposition to native customs, which have been built up as the results of large experience when animals are wanted for purposes of heavy draught,[1] is quite sufficient

[1] "Natives approve of comparatively early castration when the object is to produce cattle with speed and activity."

to account for all the so-called degeneration, which fortunately, however, would be confined to the bullocks or export produce of the herd. Extending as it does over so many years, I should assess the pecuniary loss to Government on the Amrit Mahal Cattle Farm, resulting from this blunder alone—the direct result of want of technical knowledge—at not less than some hundreds of thousands of pounds sterling: a greater capital sum than would be required to establish, for the whole of the Empire, an Agricultural department on a sound and satisfactory basis!

Restoration of the Amrit Mahal Herd.—For six years after the dispersion of the herd Government bought their bullocks in the open market; but the prices of the best sorts rose to the enormous sum, for those times, of Rs. 125 each; and it was found necessary to re-establish the Amrit Mahal herd, with all its old shortcomings, and under the newly-created disadvantages which had been induced by its dispersal.

In 1866 an effort was made to purchase as many of the original breed as were to be found, and 4000 cows and 100 bulls were got together, and pasturage appropriated for them. Much inferior blood from local or village cattle had during this time got intermingled. The natural result is, that the present breed contains many mongrels, which are known by the presence in some cases of *marls* and *broken colours*, and in others by irregular characters or weedy forms—accounting, to a certain extent, for the fact that more than half the bullock produce is most unsatisfactory.

Recent History.—The numbers rose to 6581 in 1868, and by the end of the following year exceeded 8700.

In the spring of 1886 the numbers had increased to 12,457. Up till this time 400 steers were required annually by the Government of Madras; but because horses are to replace bullocks in the 2nd Line Artillery waggons, in future only 200 steers will be required annually. It is intended to materially reduce the total number of the herd. Rs. 50 is the fixed price recorded as paid by the Government for the best bullocks; and the inferior ones, sold to the public, fetched in 1885–86 Rs. 23½. The death-rate over the herd has varied during the last five years from about 5½ per cent. to 14½ per cent. The Amrit Mahal establishment is separated into four divisions, each having four herds under responsible native herdsmen, who know every animal in their own detachments by its name, and are bound to give an account of them or become liable to a fine. The accuracy with which the elaborate stock-books, giving all sorts of interesting details as to numbers, ages, causes of death, etc., are kept, is highly commendable.

Leading Strains of Mysore Blood.—Of the important varieties of Mysore cattle which are not Amrit Mahal, the large white bullocks from the south-east, from the banks of the Cauvery River, hold the most important place. Their superior weight and strength peculiarly suit them as carriers' cattle. They are to be seen in carts on the roads leading to hill stations, such as Utakamand. Among cattle of the Mysore type, their foreheads are particularly large and prominent. The horns at first on leaving the crown of the head go almost straight back, but finally turn up with a much more abrupt bend than those of other strains. The ears are also particularly large and pendulous. The greatest defect consists in the feet being a little soft, owing to the character of their native soil. Plate IV. (*d*) shows a head which approaches somewhat to the style of this particular strain, but the horns do not go quite far enough back before turning up, and the ears do not hang down properly.

The varieties which come from the **north** of the Mysore territories are smaller and hardier, and those belonging to the **western** districts are noted for their darker colour of hair. Many of them are also inferior in quality.

Village cattle are very irregular in colour and quality, but strongly exhibit the Mysore type as seen in the lower half of Plate V. They, like the well-bred cattle, are poor milkers, the milk being, even in good years, no more than what the calf requires. In bad years, when milk is not up to the normal quantity, the calves suffer. It is found in the Amrit Mahal herd that this is reflected on the quality of the bullocks years afterwards when they go to work.

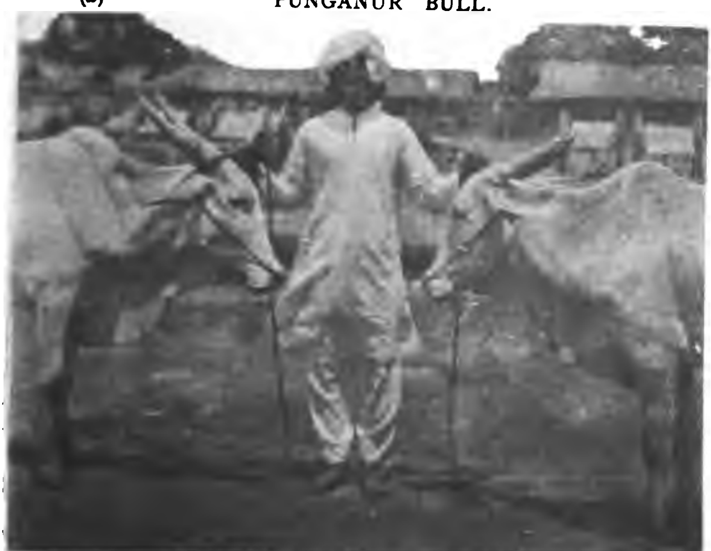
The Punganur is a small variety of Mysore. The horns curl forward more than in the pure Mysore. The legs are also shorter, and the temper milder. No doubt the latter is induced by domestication, through close association with human beings while young, the Punganur being a village breed.

The bull shown at (*d*) Plate V., with a hedge of *Inga dulsis*[1] as a background, is one of the few remaining specimens of this valuable breed, now almost extinct, having nearly died out along with the owners during one of the recent famines. The few survivors got crossed with inferior cattle, there being no one to care for them. It is much to be regretted that such a breed should have been allowed to vanish, as, in addition to combining many of the good qualities found in breeds still extant, the cows were possessed of the quality rare in Indian cattle—good milking powers. The bullocks were excellent plough cattle, as well as good trotters, in spite of the dewlap being large.

[1] This tree was imported from the Philippine Islands, but grows remarkably well in India. It provides firewood and affords good shade and shelter, but it is most valued on account of the forage which its pods supply for cattle and sheep, more especially as they are available in famine times.

Plate 5

(a) PUNGANUR BULL.



(b) COUNTRY BULLOCKS, BANGALORE.

Plate 6

KISTNA RIVER BULLOCK.

Plate 7.

GUJERAT BULL AND COW.

CHAPTER III.—CHARACTERISTICS OF BREEDS OF CATTLE.

Kistna River Breed—Gujerat Talabda Breed—Breed Degenerating—Kankreji Breed—Nagar or Wagad Breed—Sind Breed—Hurrianah Breed—Gir or Junágadh Breed—Vadhial Breed—Nellore or Ongole Breed—Two Varieties—Breed Degenerating—Malwi Breed—Deccan Breed—Southern Maratha Breed—Konkan Breed—Kaneverya Breed—Goranea Breed of Bundelkhand—Bagondha Breed—Madras Red Breed—S. Madras or Trichinopoli Breed—Dishorning—Influx of Good Bullocks—Kangam Breed—British Cattle—Imported Cattle—Aden Breed—Cinhalese Breed—Shoeing in Ceylon—Indian Village or Local Breeds—Mountain Breeds, Darjiling and Solon—Boyrup River Cattle and their likeness to the Channel Islands' Breeds—Cattle in the Gangetic Basin—Santal Country Breed—Mysore Village Cattle—The Purbi of Allahabad.

KISTNA (OR KRISHNÁ) RIVER CATTLE.

Plate VI.

JUDGING from the specimens seen, those from the upper reaches of the river, for size, massiveness, and general symmetry of parts, are in the front rank of the larger breeds of India. The *horns* are short, thick, and flattish, and thus in some respects resemble the horns of our English shorthorn. They differ in being black-tipped and stouter, and in being set further back on the frontal bone, which is broad and prominent. The *eyes* are large, full, and black; the *ears* long and drooping. The *hair* is usually white, though a few are mixed in colour, and some are brown. The dewlap and sheath are more deeply developed than usual, and joined to each other by loose skin hanging between the forelegs.

E

The bullock represented was a very fine specimen from Chinchli. It was seven years old, and cost Rs. 200. It measured in height 53 inches behind the hump, and had a girth of 6 feet 7 inches. It had a "grand" *shoulder* for a large animal—fine at the point, and joined to the trunk behind with hardly a depression visible. Its *back* was beautifully straight, and the *quarters* long and square for Indian cattle, with a much better development of thigh than usual. The leg from the knee down was very short, while the part above the knee was long. The *bone* was powerful, thin, and broad, and the *hoofs* bore a good proportion to the other parts, and had a perpendicular inclination, which is better than that of a long and flat hoof. The *feet* are good for their native district of black soil, though, like all cattle from deep soft-soil districts, their feet are inclined to be soft. For this reason, among others, they are better suited for field-work than for road-work. The *muzzle* is particularly large, and, like the hoofs, it is usually black. It had in the case before us a marvellous mobility when the animal picked up grass from the ground. The *neck* seemed to be rather short, but its great muscular development and that of the surrounding parts no doubt accounted for this apparent peculiarity.

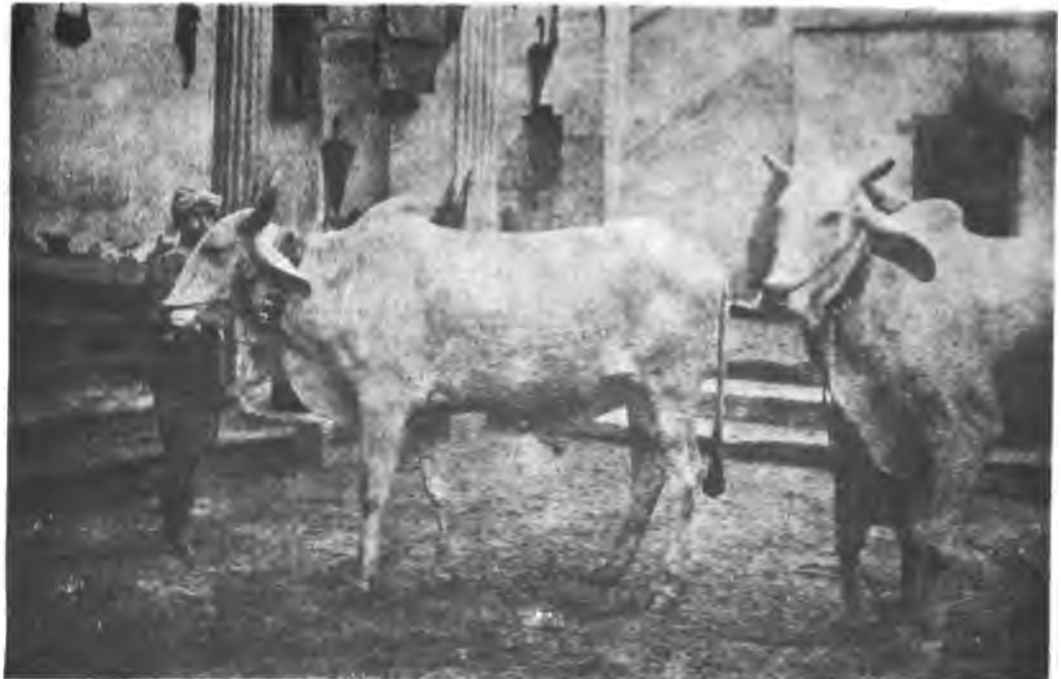
GUJERAT CATTLE.

Plates VII., VIII., & IX. (a).

Talabda is the common name of the breed, meaning local or indigenous.

It is to be found in two varieties, the *large* and the *small*, just as we find in England two varieties of Devons. **The small sort,** which, however, when compared with cattle generally, would be classed as "medium" size, is to be seen in the neighbourhood of *Bhalej* and *Marida;* the large ones in and around *Nariad* and *Pij*, etc.; but no

Plate 8.



GUJARAT BULLOCK AND HEAD OF KANKEEJI BULLOCK.

distinct line can be drawn between the regions in which the two strains predominate.

The large variety is decidedly the finest of all the large cattle of North-Western India for massiveness and various accompanying good qualities, and is only equalled by those from the banks of the Upper Kistna. A good specimen of a Gujerat bullock, which I measured in the lines at Allahabad, stood 5 feet 7 inches to the top of the hump, and had a girth of 6 feet. This breed may be described as *white with black points.* The white, however, often assumes a bluish tint in the cows, more particularly about the head. Many of the bulls are decidedly grey, and that frequently of a dark shade on the hind and fore quarters and head. The colouring of Nagar bulls is very much like that described, but they are not quite so dark. The *horns*, which are round and of a good medium size, project upwards without inclination either to the back or front. They are, however, more or less of a rounded bow shape, "bowled," curving at first outwards as they leave the crown, then inwards, and slightly twisting as they approach the tips. The *nimburi* is frequently present. The dewlap in the male is well developed in proportion to the sheath. The *ears* are large and pendent.

The *trunk* is, as it ought to be, compact and well knit, and with a good depth about the region of the heart. The *shoulders* are fine, and joined on to the neck in graceful and symmetrical lines, and are adorned in the male by a specially well-developed hump. Though the *body* is large and of good form, the qualities most to be appreciated in the Gujerat breed are to be found in the powerful and well-shaped *limbs*, and the black-hoofed *feet*,—possessed of an unusual degree of hardness and durability for large cattle,—and also in their mild *disposition* and good *temper*. These qualities mark the cows of this breed as being of all the large and strong-boned cattle of India the best suited to cross with Mysore bulls, to produce bullocks which combine the qualities of mettle, size, and endurance necessary in cattle required in the battery or transport services.

Plate VII. represents a bull and cow belonging to the Hissar farm. The bull was a good specimen, but had one conspicuous defect—want of girth in the region of the heart. The cow had nothing particular to recommend her. When photographed she was engaged licking rock salt, tied up to a pole to keep it clean.

Plate IX. (*a*) shows no such defect as that named above. This bullock was conspicuous for his wonderful neatness of shoulder, and for the symmetrical outline of his profile.

The Breed degenerating.—Gujerat cattle are widely reported to be degenerating in quality and in character as compared with what they were twenty years ago. It is accounted for by the breaking up of their runs or pastures in some cases by new settlers, who live by cultivation, and also by the system the Government has adopted of putting up the grazings in certain districts to auction. This, no doubt, appears to be just, and it is a most convenient arrangement for saving time and labour. The idea is that the lessee will distribute his right among his fellows in lieu of a moderate consideration; but as a matter of fact the plan does not always work well in practice.

In the first place, there are at times not sufficient numbers of offerers in competition to prevent them arranging beforehand (as is often done in our own auction rings at home) to plunder the seller (in this case the Government) by not opposing one another; and thus the contract is entered into below the real value of the grazing, and the Government is made to suffer. The loss to the community does not stop there. The pasture contractors let out the rights of grazing to local stock-owners, but at the same time they sell to large herdsmen at a distance the right to bring cattle in great numbers, which they do at certain times, and overstock and overpasture the area to the injury of the local breed.

Plate 9.

(a) GUJERAT BULLOCK.

(b) KANKREJI BULLOCK.

Plate 10.

NAGAR BULLOCK AND BUFFALO CALF.

The opinions of well-informed natives and of the civil officers as to the best means for settling the question are diametrically opposed to each other. It is in such a case as this that a well-appointed Agricultural Department would step in to investigate the facts, and give a report which might lead to a permanent and satisfactory solution of the difficulty.

The Kankreji Breed,

Plates VIII. (b) & IX. (b),

Is one of the fastest as well as the largest of the trotting breeds, and also the most handsome. The bullock shown in Plate IX. (*b.*) measured over 6 feet in height, including the hump. The breed belongs to a well-cultivated, flat region, intersected by the Rajputana State Railway, and lying in the north of Gujerat—stretching up to the fringe of general cultivation on its northern limits. Coming from rich, soft land, the bullocks are tender in the *feet*, which is a defect for trotting. As a remedy, the breed is frequently crossed with the *Wadhiali*, which has hard and durable feet. They are good in the plough, having been the farm cattle of their own district for generations. The *colour* is usually white, varying gradually in different specimens into different shades of a light creamy-brown colour, but a few are dark grey or brown, with silver grey on the ribs. The *dewlap* is moderate in size, which is a great advantage to trotting cattle, as a deep dewlap, swinging about as it does, tires them. The loose skin on the belly is at a minimum. The *hump* is small. The *horns* incline outwards, while taking an upward direction ; they incline backwards, and often inwards towards the points as a bullock gets old—and then the horns are much larger than in full-grown younger cattle. The *head* is well shaped, and the *eyes* are full and large. A *vein* on each side of the nose runs almost parallel with a line drawn down the ridge of the nasal bone. In most other cattle these veins are more tortuous.

The Nagar (Wagad) Breed,

Plate X.,

Is found in a region lying a little to the east of north of that in which the Kankreji breed is seen. They resemble Gujerat cattle more than any other breed in appearance. They are *large*, and mostly *white* or light grey. A number are of the light brown peculiar to Sind cattle, and many, though almost white, have a *tinge* of *brown* about the head, generally between or about the horns. Very few are dark browns or mixed colours. These were noted *cart* animals before the time of railways in India. Coming from a grazing country, and being without any hereditary proclivities or early training in farm cultivation, they are better for road-work than for the plough.

Of the cattle in North-Western India they come next to the Mysores for trotting. The breed has a *mild* and *docile disposition*. It is large and heavy in nearly all of its parts. Bullocks full grown have large hulking *bodies*, strong *bones*, large *heads*, and strong, pointed *horns*, often terminated by an elongated spiral twist, and an inclination backwards.

In Plate X. the one shown measured 5 feet 7 inches in height to the top of the hump, and 5 feet 2 inches to the base of the hump. He was twelve years old, and was wearing well, as he retained all his incisor teeth. The head was 2 feet, and the horns 2 feet 3 inches in length, and the latter 1 foot in circumference at the distance of 1 foot from the base. The ears hung very low, and the flaps or flat portions were 1 foot long and 8 inches wide at the broadest parts.

The Sind Breed,

Plate XI.,

From the province of Sind, is compact in *form* and well built, but smaller than Gujeraties, Kankrejies, or Nagaries. The *bullocks* are soft and slow at work.

The *horns* are short, moderately thick, blunt, black-tipped,

Plate 11

(a) SIND BULL AND COW.

(b) SIND BULLOCK.

and slightly flattened, like the horn of our English shorthorn; though in the matter of direction, which is outward and slightly upward, there is no parallel. The *nimburi* is sometimes present (see Plate XI. *b*). The *ears* are large and drooping, giving the *head* (which is enlivened by *eyes* of only medium prominence) a sleepy or heavy appearance to a greater degree than its size and form would usually warrant. The *face* is straight, and the head tapers symmetrically to a point a little above the muzzle. This breed has a *feature of excellence* in common with the Devon breed, viz., well packed behind the *shoulder*, which latter is also remarkable for its neatness. This is beautifully shown in Plate XI. (*b*). The *dewlap* is moderately well developed, but the *sheath* is rather under the average size. The *hump* is also below the usual in this respect. As regards *colour* of hair, perhaps white or nearly white predominates; but the breed is noted on account of the presence of many spotted or brindled cattle,—the spots, and also the colouring in whole-coloured cattle, being brown—usually of a light shade. The cows are remarkably good milkers; and at Hissar Government Stock Farm the cross-bred divisions of the herd are "dashed" with Sind blood, to improve the milking qualities of certain of the cross-bred cows that are intended to be the mothers of some of the bullocks bred for Government work. A little size is thus sacrificed for an additional supply of milk to the calf, which, no doubt, is a commendable practice, as a calf belonging to a large breed, if imperfectly nourished and stunted while young, is likely to be even a greater failure when come to mature age than a calf of a smaller variety treated in a similar manner.

Plate XI. shows one of the Hissar breeding bulls with the head of a cow looking over his back. The bullock in the lower part of the Plate is a very fine and unusually large specimen—eight years old; height, 5 feet 2 inches. His only prominent defect is in his hocks being too straight.

THE HURRIANAH BREED,

Plate XII. (a),

Or the Green Country Cattle, from the district round Hissar, are thick-set animals, with short *legs* and compact *form*, exhibiting the qualities usually found in animals chosen to carry the waterbag—*puckall.* The *bullocks* are good walkers and the *cows* are good milkers. No doubt they derive the latter quality from the same source as the Sind breed, to which they would appear to be related. The breed has most probably been dashed from time to time with Nagar and Gujerat bulls. The *horns* are short and thick, and there is a want of style about the *head.* The *colour* is mostly white or grey.

THE GIR (JUNÁGADH) BREED,

Plates XII. (b), XIII. (a), & XIV.,

From the neighbourhood of the Gir forests in Káthiáwár, is of a special type, quite different from the ordinary run of Indian cattle. **It is sometimes called the Káthiáwár, Broach, Surat, or Gujerat breed.** The *ears* are large and quite pendent, like the ears of a lop-eared rabbit. They are somewhat peculiar: the points incline inwards, and the sides coil well round, giving the ear a sort of bell-like form. The *head* is short, neat, and well shaped, the *forehead* being particularly broad and prominent. It is made to look all the more so by the backward inclination of the *horns*, which, in the male, though short, are thick, flattened, and crumpled in a peculiar way, so as to resemble somewhat the horns of a bison. The horns of the female are considerably thinner, and black in colour like those of the male.

The *eyes* are black, with a mild expression; they are shaded by a heavy upper eyelid. In the matter of depth of *dewlap* and *sheath*, the Gir rivals the Nellore breed. The cows are, like the Nellore, also noted for their milking powers, supplying most of Western India with milk cattle.

Plate 12.

(*a*) HURRIANAH BULLOCK.

(*b*) GIR BULL.

Plate 13.

(a) GIR COW.

(b) VADHIAL COW.

Plate 14.

MILKING COWS, BOMBAY.

Plate XIV. is from a photograph taken on the Esplanade, Bombay, and exhibits the common milking herd of the city.

The breed does not stand high, but the bullocks have large, good feet, and are extremely short-legged, strong-boned, thick-set, and powerful, making good draught animals.

The common *colour* of the cow is light brown ; the colour of the bull is a darker brown, with the greatest depth of colour at the points or extremities. The *tail* is thinnish, and is terminated by a bushy black brush of hair. Some cattle of this breed are white, with more or less brown on the legs and inside the ears. Frequently, in addition, there are brown patches or spots on the head and neck : these may also appear on the body. The brown variety is considered to be the best type of animal. No doubt the spots have crept in by cross-breeding in the past.

History.—The refinement of parts, peculiarity of type, and fixity of character, show that considerable care has at one time been bestowed on the management of this breed of cattle. There is a tradition that they originally were not Indian cattle at all, but that they were imported from the West. The marked difference in some particular points, as compared with Indian cattle generally, would incline one to this view.

THE VADHIAL BREED,

Plate XIII. (b),

From the district lying to the east in the Káthiáwár Peninsula, bears a strong resemblance in appearance and character to the **Gir** breed, and in former times must have been identical with it.

Comparison.—The milking qualities, colour, prominent forehead, and crumpled back-set horns are identical, but the heavy eye-brows are absent in the Vadhial. The latter belong to a country with short grass, while the Gir in its native home eats long and luxuriant grass. The Vadhial coming from hard lands have qualities suitable for the working of such soils. They are quiet and strong, though rather slow. The cows are much crossed with Kankreji bulls in and around Nariad.

THE NELLORE OR ONGOLE BREED,

Plates XV. & XVI.,

From a region lying north of Madras, is one of the most noted and widely known in India. It is the great milking breed of the Madras Presidency; and Nellore cows may now and then be seen in most districts of India.

There are two varieties, the large and the small; but their expression of countenance and other distinguishing typical characteristics are so much alike, that in describing the leading features of the breed it is unnecessary to draw a line between them except in a few particulars.

The smaller cattle have short legs, and are more compact and hardy. These qualities come out prominently when they are located in hill districts, for which they are well suited. They are also the better milkers of the two, and are particularly so when not placed under the conditions most favourable for milk production.

The animals of the large variety are leggy, and, as a whole, their figures show they are not so well knit together as the others. Though they do not milk so well as the smaller ones, taking their size into account, yet they are universally recognised as belonging to one of the best milking breeds.

The true *colour* of the breed is white with black points, and frequently a slight shading of grey in the male. The one from which the upper part of Plate XV. was taken (a stud bull at Hissar farm, aged eight years) is quite exceptional in his colouring; and although his form is typical of the breed, and he is in himself a well-proportioned animal, I do not believe he is pure bred, and he will in

Plate 15.

(a) NELLORE, OR ONGOLE BULL.

(b) NELLORE BULLOCK

(*a*) NELLORE COW.

(*b*) NELLORE COW AND MILKMAN.

consequence probably not breed satisfactorily. His dark parts are very deep brown, almost black.

The *horns* of the male are short, and, for the length, stout and sharp pointed. Those of the female are longer than the usual proportion, and are likewise sharp pointed. Both are pretty straight, and have a distinct inclination backwards, which begins at the roots.

The *ears* are of good size, and decidedly drooping. They give, along with the mild temper and gentle disposition, that air of docility which should form a foremost characteristic of a milking breed.

In ancient times Nellore cattle were remarkable for the extraordinary development of *dewlap* and *loose skin*, which depended from the under surface of the body as a continuation backwards of the dewlap. Although not now so large, they are yet able to compare favourably with the corresponding appendages of any other breed in India.

The larger variety in point of *size* is inferior to Gujerat or Nagar cattle, while being superior to the Sind breed. Though the bullocks are sought after on account of their size, they are not good cattle on hard land, being soft and tender footed, and at best they are too mild mannered. They are consequently not adapted for trotting.

This is one of the noted breeds which is reported to be *degenerating*, or to have degenerated, both in substance and quality. From ancient descriptions and ancient drawings, this would appear to be correct. There is no question about the fact that distinct traces of high quality in breeding are clearly visible at the present time, quality which could never have been reached by the ordinary systems of management.

Plate XVI. (*a*) gives an excellent representation of a good, well-bred cow in lean or milking condition. She shows good depth of dewlap, but an absence of hanging skin on the belly. On the Plate, (*b*) represents a cow of this breed being milked with her hind legs tied in the usual way.

Plate XV. (*b*) shows a well-formed, medium sized bullock. In comparing his hump, dewlap, and sheath with the corresponding parts of the bull above him, it is interesting to notice how much smaller they are on the bullock—how much more cow-like.

THE MALWI,

Plate XVII.,

A small white breed, in the Province of Malwa, and reared chiefly on the Satpura hills.

The bullocks, which are fine-boned and handsome, make very good plough cattle, and are imported to all parts of the Deccan by *vanjaries* or wandering herdsmen. It was computed (but with what pretensions to accuracy I am unable to say) that some 30,000 bullocks, mostly three years old, were distributed over this region last year—1886. It would be more correct to say that they come as three-year old bulls, to be subsequently emasculated. A. Stormont states: "They are then kept for a year, during which time they are gradually trained to the yoke, in their spare time grazing freely in the village herd, the cows of which they serve. This is supposed to develop the masculine form, so that they are usually fit for castration at four years old."

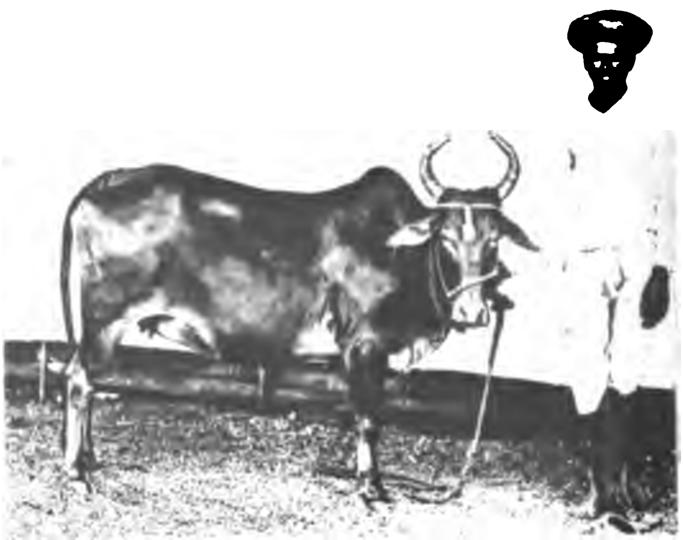
The cows are fair milkers and symmetrical in *form*. The *nimburi* is altogether absent in the breed, which helps to mark them off as quite distinct from the Deccani. This is, however almost unnecessary, as the *style* or general appearance of the Malwi breed is peculiarly its own. This is most markedly the case with cows. The bullocks by some are thought to resemble the small variety of the Gujerat Talabda. The *horns* in both male and female are wide and upstanding, but not heavy. In the female they resemble two arcs of a circle set on the crest of the head, with the concavity inwards. In the male they often bend further back. The *dewlap* is present, though not

Plate 17.

MALWI BULLOCK.

MALWI COW.

(*a*) DECCAN BULLOCK.



(*b*) . DECCAN HEIFER.

large, while loose skin in the abdominal region is absent. The *ears* are neither large nor pendent, though set on so that they have a slightly downward inclination. The Plate represents a cow and bullock in unusually high condition, having been fed for a show.

THE DECCAN BREED,

Plate XVIII.,

Is irregular in type, size, and colour. The best of them are fine massive specimens of good size, making valuable working cattle. A common *colour* is brown of all possible shades, from the deep, rich red to light fawn or cream colour; and associated with the brown it is not uncommon to see *rings* of a dark shade round the hoof-heads and a light-coloured ring round the muzzle, shading off indefinitely at its upper edge. The same light colouring may also appear on parts of the under side of the body. I have noticed specimens of this breed, and also of the Mysore, with little white spots like flakes of snow dotted all over the animal as on the skin of a spotted deer. White or light grey is also a common colour.

Quality of Bullocks.—A small and compact variety from Berar makes excellent trotting bullocks, worth about Rs. 65 to Rs. 70. Some of these, of a dark brown hue, shading into a tinge of red on the ribs, are very handsome and active, nodding their heads in trotting, like a horse, in place of swinging them from side to side in the laboured way which bullocks do, especially as they get tired. I heard on good authority of a pair of Deccani trotting bullocks from the Inder district, in the north-east of the Nizam's territory, drawing a light cart with camp furniture a distance of 120 miles within two days.

Points.—The *ears* of the breed are of moderate size, pointed, and well carried. The *horns* are decidedly strong for their length, springing upwards and outwards, with blunt black tips, and a slight curve towards the inner side. Those of the male resemble very often the horns of the Ayrshire bull. The *nimburi* is a usual characteristic of the breed. The dewlap is of moderate depth, and the hanging skin on the belly is generally wanting.

SOUTHERN MARATHA CATTLE,

Plate XIX.,

Are called **Jowárí**[1] in their own country, on account of being bred in the district. They are not by any means of one type. There seem to be **several strains**, with distinct peculiarities of certain parts—for example, the horns and coloured patches of skin which seem to be associated with one another, and run in groups. *One variety* of dark brown cattle—almost black on the quarters, though lighter over the "barrel"—has in many instances a strip of light brown or grey up the anterior portion of the back ridge, terminating with the hump. Correlated with this peculiarity, which, by the way, is also present in some Swiss cows, is even a more striking one,—light patches of a shade corresponding to the above are seen on each side of the upper lip, giving a moustache-like appearance. The inside of the ears and a fringe along their edge are also light in shade.

Others, again, are of a light, yellowish, uniform brown, though of various shades (down to creamy white) in different animals, while some are broken in colour—mottled black and white. As a rule, the dark colours predominate. This unusual variation is a direct indication of mixture of breeds. A distinctly characteristic style of horn is one which assumes a V shape—two fairly long straight horns, almost uniformly thick until near their terminations, where they abruptly taper in a manner not un-

[1] Jowárí being the name of the common grain, everything that is common is called Jowárí.

Plate 19.

(*a*) S. MARATHA BULL.--A YOUNG CULPRIT.

(*b*) S. MARATHA BULLOCKS.

(a) KANEVERYA.—2 Year Old Bull.

(b) THE GORANEA OF BUNDELKHAND.

like a composite or paraffin candle, and rise up, at the same time, with an inclination backwards. See Plate XIX. (*b*).

Another type of horn is bent, and inclines much backward; and *yet another* is seen in the poorer forms of cattle—those having more of the old original common blood in them—with the horns inclining forward like the red cattle of Madras.

Development.—Where the soil is rich the cattle are large and strong, and able to draw the ploughs, which are here too large and heavy for a man to carry, and are laid on to the yoke to be conveyed to and from the field. On the light and often very poor soils met with in the S. Maratha country, the cattle, although of the same type as the better sorts mentioned above, are often exceedingly poor in comparison with them. The humps in such regions are greatly reduced in size.

Konkan Cattle,

Plate XXVI. (*b*),

Retain decided traces of the ancient aboriginal breeds of cattle.

Characteristics.—They are mostly black and white, dun, red, or brown in *colour*, shading off to dark brown or black near to the points. The *horns* are irregular, but usually rise up more than in the case of those shown in Plate XXVI. (*b*). In other respects the two bullocks are typical representatives of the best class of this local breed. *Bullocks* fetch per pair, according to quality, from Rs. 40 to Rs. 250, and trot easily in a light cart at the rate of seven or eight miles an hour.

The Kaneverya Breed,

Plate XX. (*a*),

From the banks of the river Kane, is the local breed at Banda. These cattle are much more *handsome* and more compact than the Goraneas mentioned below, but, though hardy, are not so mettled when put to work.

The *colour* of hair is usually an uniform brick red all over, with the exception of the face, which is generally white. At times there are white spots or patches, more particularly about the belly or lower parts of the body or limbs. The original of the Plate, although a very fine and characteristic specimen of its breed at the age of "two years off," shows an unusually large amount of white. The *skin* under the hair and the hoofs is a deep chocolate colour, and the tips of the short, stout, erect *horns* are red-brown. The *feet* are neat, and the *leg bones* short and powerful. The depth of the *body* at the heart is exceptionally good. The *hump* is well formed, and the *dewlap* is large, but there is only a scanty representation of the pendent *belly skin.* The *ears* are of a moderate size, and the inclination downwards is only slight.

THE GORANEA[1] OF BUNDELKHAND.

Plate XX. (b).

Plate No. XX. (lower half) shows a young bull a little over two years old. He consequently looks leggy and not "filled out." The *colour* of the breed is dark grey, with the ribs and brisket of a lighter shade. A ridge of light brown, almost white, passes along the crest of the backbone. Round the pasterns, and also round the muzzle, there are rings of a light shade. The latter marking is termed in this country "mealy-mouthed," from the striking resemblance which the colouring has to that presented by the mouth of a cow after a feed of meal.

The *horns* are black tipped, long, and pointed, being of a medium thickness at the base, and thinning towards a sharp point throughout nearly the entire length. They are widely

[1] Goranea = indigenous: like Talabda in Gujerat, and Jowárí in the Southern Maratha country.

MADRAS RED TROTTING BULLOCK.

set apart over the poll, open outwards, and, together with the sharp-pointed, medium-sized, and well-carried *ears*, give a sprightly appearance to the countenance.

The *hoofs* are neat and hard, and on this account the feet are never shod. The *bones* are fine and clean; and the *tail*, remarkably thin and whip-like, terminates with a luxuriant tuft of black hair. The *neck* is deep, rather short, and it is not so hollow immediately in front of the hump as is usual in other cattle.

In *size* it takes a medium place, but is superior in the matter of height to the Kaneverya breed.

As workers, these cattle are pronounced to be the best of all the varieties tried within recent years on the Government experimental farm near Cawnpur.

THE BAGONDHA

Cattle are **hornless,** rather over medium size, and belong to Oudh. They are usually grey in *colour*, but range from dark grey to white. They are said to be good *cart bullocks*, and are found employed as such in various parts of Northern India.

I did not chance to meet any specimens of this breed. I am indebted to Mahomed Hossain, Assistant Director of Agriculture at Cawnpur, for the above information.

THE MADRAS RED BREED,

Plate XXI.,

From **Chengalpat and Arkot,** is mostly of a light brick-red *colour*—few being white, grey, or broken colours. They are of small size. One of the prominent features is the forward inclination of the horns, which become more distinctly characteristic as they arrive at mature age. Some have slightly hollow or "dished" *faces*, made all the more observable by the position of the horns. The *bones* are fine. The *hump* is small, even in the case of well-fed cart bullocks.

Though standing about the same height, they are less hardy in stormy weather, and not so valuable as the Trichi breed, found in the region to the south of the river Pennar.

Plate XXI. represents a trotting bullock, which, though small, shows distinctly the typical characters of the breed.

THE SOUTHERN MADRAS OR TRICHINOPOLI BREED,

Plates XXII., XXIII, XXIV., XXV.,

Is mostly of a white or light *colour* of hair.

Location.—Brown specimens are to be seen everywhere, but in some places these are more abundant. South of Dindigal there are many light browns and creamy-shaded whites, and about Palamcotta and to the west of it, the colour becomes decidedly deeper—various shades of brown, some approaching to black, predominating. Those seen on the rich tract of black cotton soil in the district of Tinnevelli, south of Madura, are large and well cared for. They are mostly white, and the horns, which are fully developed, as might be expected on well-fed animals, incline slightly forward at the points as the animals get old,—see Plate XXIII. Again, on the black soil of Koimbatur, cattle of a similar stamp predominate, but in this district, where poor, thin, red soil occupies the surface, the variety deteriorates.

The *skin*, *eyes*, *muzzle*, *hoofs*, and *hoof-heads* of the breed, with the exceptions already referred to, are of the deepest shade of black. The *horns* are, as a rule, rather short and erect, and do not spring much during the first two years.

Dishorning.—The horns are frequently suppressed, particularly in the northern part of the district, by firing or branding any time before they begin to shoot out. A flat bar of iron is heated and pressed upon the points of the budding horns, completely destroying them, and leaving the animal as if it had belonged to a polled breed. This practice seems to me to destroy one's confidence in the

Plate 22.

SOUTHERN MADRAS BULLOCK AND COW.

Plate 23.

TRICHINOPOLI CART BULLOCKS RESTING.

Plate 24

(*a*) SOUTHERN MADRAS BULL.

(*b*) KANGAM COW.

evidence taken from ancient Egyptian and other coins in favour of the existence of polled breeds of cattle in those remote times. The polled condition might have been artificial!

Disfiguration.—Cattle are further mutilated in these parts by their ears being cut and scored in a cruel manner, and for no particular object, except the appearance, which can, after the operation, only gratify a depraved taste; and, again, they are scored with a hot iron also by way of ornamentation, and for other reasons yet to be stated.

Influx of Good Bullocks—The working strength of the southern districts is added to by purchase of imported cattle, usually of the Mysore breed, at large periodical fairs held at important centres, such as Salem, Bangalore, and Trichinopoli. As these animals are often castrated, they do not in those instances mingle blood with the local breed.

The Kangam Breed,

Plate XXIV. (b),

Of Koimbatur, is undoubtedly related to the Trichinopoli breed, but it is more refined in style, and altogether more handsome.

Milking Powers.—It is one of the best milking breeds, although one of the smallest of this class in the country. The height of the cow in Plate XXIV. (*b*) is 3 feet 6 inches behind the hump. It has given as much as 20 lbs. of milk a day, besides leaving the usual very limited proportion (said to be one-eighth) for the calf, and would undoubtedly milk as well as an Aden cow if it were as well fed, which is not the case in ordinary practice. The Indian cow, like a prophet in his own country, is not appreciated sufficiently to be properly fed and tested against Aden, English, or other imported stock. When not giving milk, the cows of this breed are sometimes put into the plough to work in place of bullocks. It is rather strange to find this custom existing in India, as Hindoos hold the cow so sacred that they will not, as a rule, hear of her being reduced to perform the duties of a menial office. The *colour* of the eyes, nose, and points is black.

The *shoulder* is remarkably neat. The *thighs* are well-rounded, but are not fleshy. The *leg bones* are thin and refined, showing signs of breeding. The *escutcheon* in this case is very wide, high up on the thighs, and even between the hip bones; it tapers as it descends. The colour of the *udder* and teats of many specimens of this and the allied Trichi breed is tan. At times, too, the *chocolate colour* of skin appears.

British Cattle

Belong to the species *Bos taurus.* Many different breeds have been taken to districts representative of all varieties of Indian climatic conditions.

Unsuccessful.—In no case have the efforts to establish European blood, either in its pure form or crossed with native cattle, met with that success which would warrant those who have gained experience in the matter to continue their efforts on anything but what we might term a "hobby" scale. Some of the reasons why European cattle do not succeed have already been pointed out. English cattle live and even thrive if properly cared for and sheltered, but they must be pronounced a failure when left to the natural influences of climate, such as the native cattle are enabled to withstand. In saying they thrive it is not implied that they retain all their good qualities, as when kept in the best possible way European cows cannot be got to yield anything like the quantity of milk that they give at home, and their crosses, which are only middling milkers at the best, unless highly fed and carefully nurtured, are very poor indeed.

Plate XXVI. (*a*) shows a cross between a shorthorn bull

Plate 25.

(*a*) WOMEN PLANTING RICE SEEDLINGS.

(*b*) PLOUGHING UNDER WATER IN PREPARING LAND FOR RICE.

Plate 26.

(*a*) SHORTHORN AND DECCAN CROSS BULLOCK.

(*b*) KONKAN BULLOCKS.

and a Deccani cow. This bullock is a fine, large, fleshy, powerful animal; but in the height of the season, although his skin is not nearly so light coloured as many of the skins of cattle bred in the same way, he has to be taken out of yoke during four hours of the heat of the day when native cattle can continue to work without suffering.

Imported Cattle

Seem to succumb more readily to disease than native cattle; and on account of this, much unnecessary loss has been entailed through high-priced animals being selected in place of lower-priced well-bred ones of ordinary appearance. Instances have been given of prices paid for bulls ranging from £150 up to £300, when the class of animal which would have suited the purpose best could have been bought in England at 20 guineas. I should add that those high-priced animals rarely survived a few months.

In crossing native with English cattle, one of the most extensive and successful efforts which I had the privilege of personally inquiring into, was carried out by the Rev. G. M. Wilson, near Darjiling, where the climate is much more favourable for the purpose than down at the lower levels. One specimen (in some cases two) was got out from England of each of the following breeds:—Hereford, Devon, Ayrshire, and Guernsey. The latter threw the best crosses.

The colouring of the progeny as a whole is both interesting and extraordinary. Whole colours practically disappeared, and brindles and all sorts of broken colours ruled. The most common type of the latter, especially coming from the Guernsey, may be thus described:—Black or brown ears, eyes, muzzle, and hoof-heads, with spots of one or other colour along the sides, leaving the head, legs, back, belly, lower neck, and brisket white, or frequently with a yellow tinge, and a few spots of the dark colour (black or brown) dotted through it.

In the first cross between European and native cattle the hump is very much reduced, see Plate XXVI. (*a*), and it practically disappears in future crosses. There is also a tendency for the hind-quarter to become longer and less drooping than in the case of the indigenous cattle.

Altogether the greater potency of the British races—a quality derived from careful breeding—asserts itself, and we have upon the whole more tendency in the crosses to assume the external form of the English rather than of the Indian breeds. In the matter of milking qualities, however, these crosses do not resemble their English progenitors; but that is easily understood when one thinks of how very susceptible milking properties are to change by local surroundings.

Milking Powers.—A good cross cow on natural food gives in the Darjiling district from five to six sers of milk daily, or about five to six quarts. This may be also reckoned a good yield in any part of the country for a cow of the best Indian milking breeds, such as Nellore or Gir. The yield may be somewhat increased if the animals are artificially fed, but feeding in the neighbourhood of Darjiling injures the quality of the butter.

Leeches in enormous numbers suck the blood from the legs and tender under parts of the bodies of cattle during the four wet months in the Darjiling district, and must materially reduce the power of the animals to manufacture milk.

Cattle of the Aden Breed,

Plate XXVII.,

With their short, well-formed limbs, are more compact and symmetrical than Indian cattle generally are.

Plate XXVII. shows a bull and cow of the usual *colours*, *i.e.*, for the male, light brown or dun, with a "mealy" nose and dark points; and for the female, white.

Points.—The *hump* is very large (especially on the male),

(*a*) ADEN BULL.

(*b*) ADEN COW.

Plate 28.

CINHALESE TROTTING BULLOCK IN NATIVE CART.

and extends far forward on to the neck. The *ears* are small, and the *horns* are extremely short and thick, but with a tendency to splinter or crumble. This bull was six years old.

The cow was fifteen years old, yet exhibited remarkably well the shape and general characters of her breed, which is noted, and possibly at the same time over-rated, for its milking powers. The general *form* is that of a milking type—deeper in the hind-quarters than in front. The dewlap is prominent, but pendent skin from the belly is absent. Numbers have been imported with the object of crossing with native cattle to improve the milking qualities.

The bullocks are small, but powerful. Although they belong to the same species, and resemble Indian cattle very closely, even to the matter of the voice, they are not so hardy when exposed at work to the full effects of the climate.

Cinhalese Cattle,

Plates XXVIII. & XXIX. (*a*),

Are usually classed in two divisions—(1) The *small native breed*, and (2) the *large coast cattle*. The latter are mostly imported from India, and consist largely of Mysores and their crosses.

The local breed first mentioned are the true cattle of Ceylon, and are possessed of beautiful shapes. They are remarkably like Adens; and though small, their *bodies* are extremely well proportioned. Their *heads* and *feet* are both large and clumsy. The head is long, does not expand at the setting on of the horns and taper towards the muzzle as it ought to do to look well. The *ears* are small and sharp, but only moderately well carried. The *horns* are short, thick, and blunt, and point upwards, but do not spring much till the animal is approaching three years old. The *colour* of hair is generally black, with black nose, skin, and hoofs. A few are of a deep rich brown, with chocolate skin and points. These are thought to be the more beautiful of the two, but not so hardy. Still fewer have broken colours,—white patches on the prevailing black or brown; and in some rare cases, patches of brown on the black.

The *legs* are short, and the *bones* fine. The *barrel* is round and substantial. The *hind-quarters* are unusually long for Indian cattle, and carried out square, or on a line with the back to the setting on of the tail. Behind the *shoulder* they are as well filled up as the best of our home breeds. The *hump* is thick and massive, and very often double. The *dewlap* is prominent, and there is no hanging skin on the belly.

Plate XXIX. (*a*) shows an excellent specimen of a bull, but with the one little defect, which no doubt will disappear with age—want of depth of barrel. He was, at the time the photograph was taken, not quite 3½ years old (but had six teeth), and measured in height 3 feet 5½ inches. He had worked for a year, but being well fed and cared for, he had not suffered, as might have been expected, from going to yoke at such an unusually early age. Good treatment was evident from the number and appearance of his teeth.

Cattle are shod with thin or thick shoes at a cost of 1s. or 2s., as the case may be. The nails used have large round heads like great coarse rivets, and a passage is made for each nail through the hoof by a carpenter's brog. In the case of the outer digits, the sharp points of the nails are neatly coiled upon themselves and left as ornamentation; the inner ones are cut off and fastened in the usual way. The operation has to be repeated once every two months in the case of animals working on hard roads.

The bullocks of the breed are not noted as quick movers, but they are possessed of great power of endurance and wonderful strength for their size.

(a) CINGHALESE BULL

(b) MOUNTAIN CATTLE NEAR SIMLA.

The cows of some of the strains up country are rather good milkers, and if properly selected and managed, might supply the material from which a good milking herd could be produced.

Branding is more neatly performed, and even more widely practised in Ceylon than in Madras.

Indian Village or Local Breeds

Of cattle, many of which are not sufficiently important to be specially named, are the representatives and remains of the ancient aboriginal breed or breeds that inhabited the country before the waves of importation, which periodically flowed over the land, had come. They have been driven into country villages or into remote corners, such as mountainous or inferior districts, where, by dint of lengthened association with often adverse influences, the breeds, though often set down as miserable and unprofitable, are generally extremely well suited to their surroundings in the points of essential importance, *i.e.*, soil, climate, and food. To attempt to cross them with larger animals of finer build would undoubtedly end in disaster, unless the treatment and general circumstances were altered to suit the new forms. The only method of improvement which will end successfully is that of selection, combined with greater attention and better treatment. With these, time only is required to accomplish almost any common object in breeding.

The colours of these breeds are decidedly darker than the colours of the breeds of greater substance and larger size. Black and brown are most familiar colours among local cattle.

The Dangi or Hill cattle in the district round Igatpuri are small and miserable-looking specimens, with irregular, thin, tapering *horns;* the *nimburi* is invariably present. The *colours* are usually black or brown, speckled with white. They are extremely hardy, and withstand the excessive humidity of the climate, being able to work in water like buffaloes.

At Darjiling there are two common breeds. The *Sikim* is the best milker, and the *Nepálese* is the smaller of the two. They are mostly black in colour, a few being red and white. If brindled, they are not so good milkers.

Plate XXIX. (*b*) **shows Mountain Cattle** seen on the Himalayas on the way from Solan to Simla. They are small, and in shape resemble a cross between an ordinary Kerry and a Dexter Kerry. *In colour* they are mostly black, but a few are grey, and some are brown or a brownish dun, with dark mouse-coloured points. The animals shown are eating the leaves from the boughs of a tree which have been broken off, in accordance with a usual custom, and thrown to them. The *hump*, as in all mountain cattle and most local breeds, is much reduced, or almost wanting. The breed is very hardy, and their short legs and active figures adapt them admirably to the steep and poor mountain sides, on which they live and thrive.

The Cattle of the Boyrup River, seen on its banks not far from Jessor, are small, but handsome, though kept in very poor condition. They eat very coarse, hard grasses, which may be taken as an indication that the natural supply of good food is not over abundant.

Likeness to Channel Islands' Cattle.—The humps are extremely small, and, with their fine bones, spare forms, and many specimens of a light fawn colour of hair, they more strongly than any other cattle in India remind one of the Channel Islands' breeds ; but I do not for a moment believe that they are connected in any way with these Europeans.

The Cattle in the Gangetic Basin, seen from the train on the level lands lying north of Calcutta on the way to Darjiling, are numerous. They are to be seen in considerable village herds going sometimes miles to pastures on the banks of a river. The prevailing *colours* are light, and the animals generally are smaller, and lack the substance possessed by the breeds of Western India. This is the result of the climate, the consequence of its excessive wetness, which is not suitable for the breeding and rearing of stock of this class. The above remarks apply to the cattle seen from the train for a considerable distance west after leaving Calcutta. The herdsmen, to protect themselves from the rain, wear native home-made umbrellas constructed of palm leaves fastened to bamboo ribs and handles, and shaped like the hats of Noah's Ark men.

Santal Country Breed.—The local cattle around Pokhuria, on the southern banks of the Barrakur River, are very small and hardy, but kept up in numbers to the limit of the natural food supply. They furnish an excellent illustration of a breed which could only be improved by selection of good specimens from among themselves, as no imported cattle could possess the qualities of endurance and long-suffering attained in the local breed by generations of semi-starvation. The colours are generally black and brown, or at times they may be broken.

The Mysore Village Cattle of the poorer sorts, Plate V. (*b*), show a strong dash of the pure Mysore blood, which had no doubt been used to improve the local breeds. Small and active animals of much the same type are to be seen from the railway going from Bombay to Madras in the district lying north-east of the Mysore country. The horns of the latter, however, incline to bend more forward than in the others, showing that the original native mother on which the Mysore bull had been used must have been somewhat different from the mothers of the village breeds of Mysore.

PURBI is the name given to the best local bullocks at Allahabad. It implies that they come from the East, and in reality they came from the region near to Muzaffapur. Though small, they are compact and hardy. The colour of hair is usually white on the body, but with a brownish tinge about the head. The horns are short and the ears hanging.

Diminutive Cattle,

Plates XXX., XXXI. (a), & XXXII.,

Are represented throughout India by various breeds, which, when full grown, measure less than 30 inches in height behind the shoulder. The best specimens are extremely handsome and well bred, and for their size most active, powerful, and willing workers as trotting cattle in little carts built to suit them.

Plate XXXI. (*b*) shows an excellent typical specimen of a bull, worth Rs. 15, standing 35 inches high, measured behind the hump. The colour of hair is white, but the skin and hoofs are chocolate, and the nose flesh coloured. The whole animal forms a pattern of neatness and hardiness. It trots with ease at the rate of 6 or 7 miles an hour with two people in the cart.

The three specimens represented in Plates XXX. and XXXI. (*a*) are all varieties from the Malabar coast, which are brought by the people from that district when they come to attend religious festivals and fairs at important centres like Trichinopoli. Each measures about 29 inches in height behind the hump, and has black skin, nose, and hoofs. One has grey hair, another light brown, and the third, which is an exceedingly compact as well as beautiful little creature, is a combination of light brown and dark brown with white points. In value they range from about Rs. 6½ to Rs. 10 each.

Plate XXXII. was taken at Cawnpur. The two little light-grey bulls exhibited looked very neat and handsome, but were in too high condition to do much work.

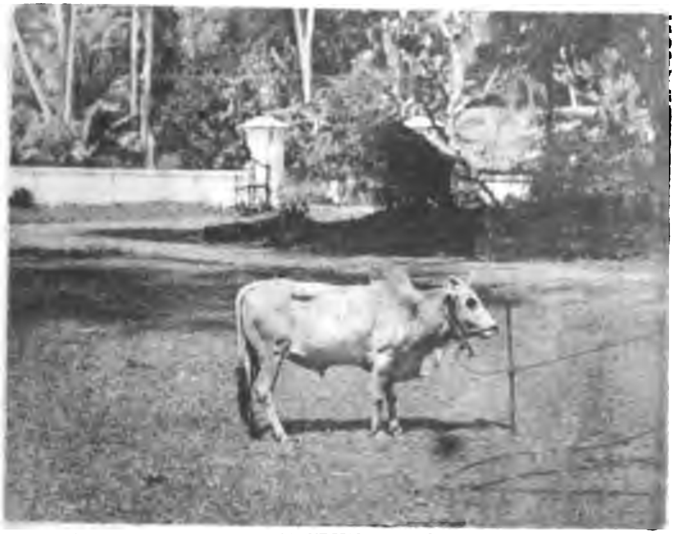
In Madras great varieties of diminutive trotting bullocks are to be seen. Many of them have a strong resemblance to Mysores, both in the shape and inclination of the horn and in the general appearance.

Plate 30.

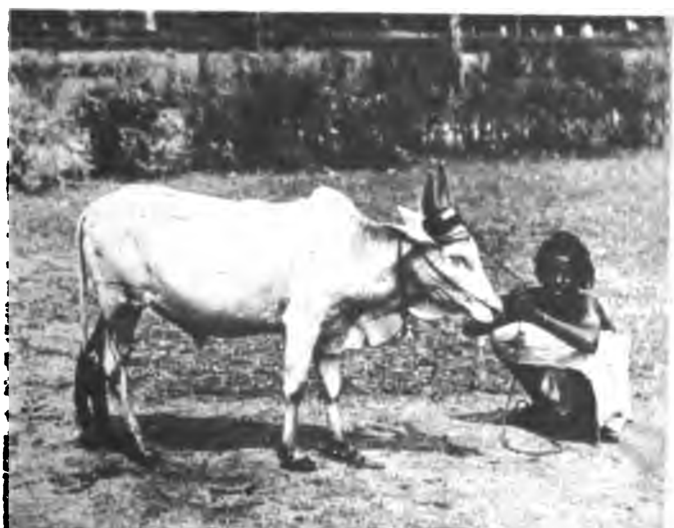
a) DIMINUTIVE BULLOCK.

b) DIMINUTIVE BULLOCK.

Plate 31.



(*a*) DIMINUTIVE BULL.



(*b*) SEMI-DIMINUTIVE BULLOCK.

Plate 32.

PAIR OF DIMINUTIVE BULLS IN CART (CAWNPUR).

CHAPTER IV.—CATTLE—GENERAL OBSERVATIONS.

Housing of Cattle—Sanitation—Distribution and Pasture of Cattle—Feeding—Examples of Feeding—Bhusa—Ages judged by the Teeth—Other Indications of Age—Branding—Bulls—Bulling—Forcible Connexion—Brahmani or Sacred Bulls—Sacred Brands—Castration—Indian Methods and their Advantages—The Effect of Early Castration—Ignorance of Europeans in India regarding Castration—An Alternative for Early Castration—Hobbling—Driving—Native Drivers and their Pride in Ornamental Decoration—The Panjrapol.

GENERAL OBSERVATIONS.

CATTLE are usually kept either under the roof of the human habitation or in the court-yard of the house; and I believe the health of the owners does not in the least degree suffer in consequence, while they are by the arrangement left in the possession and full enjoyment of their own property—the products of the cow—which under a different system would certainly not be the case. So long as the floor of the cow's bed is at a lower level than the floor of the house, and kept scrupulously clean, as is the custom, the drainage being at the same time carried away from the well or source of water supply, there can be no possible injury to the health of the family from the wholesome, and by no means disagreeable, smell of a healthy cow.

Sanitation is decidedly stepping out of its province in doing anything more, as regards conditions conducive to health, than to secure for a village a good drainage system, a good and pure water supply, and freedom from the objectionable and injurious presence of human excreta.

Distribution.—Cattle are bred to a greater or less extent in most districts, but, as a rule, the thickly populated localities have not sufficient room for grazing young cattle before they come forward for use, and in other parts the **soil or climate** is not suitable for the healthy rearing of the best quality of cattle; for example, the wet region of North-Eastern India, including the greater portion of Bengal, is unsuited to the extension of local breeding. The drier and less cultivable regions bordering on the great desert of North-Western India are in every way better adapted for successful cattle rearing. **Pasture** is abundant, except during seasons of drought, and it is not seriously encroached upon by the extension of cultivation. There is in these parts no excess of moisture to which cattle are not suited, as buffaloes are suited; nor are internal parasites so prevalent, on account of, among other reasons, a greater supply of salt being retained by the soil. The consequence is, as might have been expected, that large herds of cattle are kept in this and various regions, more or less similarly situated, and the surplus stock of bullocks periodically distributed by gipsy and other drovers to parts not so favoured as regards conditions necessary for stock rearing. I may mention, merely by way of illustration, the grazing lands of Mysore, Káthiáwár, and the Sátpurá hills, as regions from which superior bullocks are drawn, the larger and stronger of them being in considerable demand for carting on the road, the lighter and more active ones for the bullock bandies (carriages), possessed by most natives as well as Europeans who can afford the luxury. These are in addition to the few superior work cattle that natives of substantial means usually have on their holdings for special work requiring strength.

Feeding.—Although it is a fact that the feeding of cattle is much neglected, and that in some places animals suffer severely from want of a supply of green or any food during the dry part of the hot season, it is a mistake to imagine that all cattle are starved. Trotting bullocks are usually kept in good hard condition by being fed with a supply, extra to the natural coarse or bulky food, of 6 or 8 lbs. per day of gram or cake of various sorts. With the poorer village cattle, in the possession of poor cultivators, it is too frequently the practice to turn them out at noon from the yoke, and allow them to forage for themselves during the remainder of the day. In the country of the *Santals*, I found that when cattle were well cared for, as while carting, they received one ser per day of the fleshy raisin-like flower of the Mhowa tree, *Bassia latifolia*, or oil cake of the same value.

Marwa, the refuse from native breweries, is given to cattle in some parts as a stimulating and palatable food after hard work. When animals are over fatigued and refuse to eat naturally, it is sometimes put by hand into the back of the mouth.[1]

Examples of Feeding.—At Shiyali, on the Madras coast, I found a wealthy zamindar, who farmed about 4000 acres of his own land, feeding his work cattle on cake made from the ground-nut or pea-nut, *Arachis hypogæa;* 2 to 3 sers being allowed per day to each bullock while at full work, at a cost of Rs. 8 to Rs. 10 yearly.[2]

Trotting bullocks get 4 sers of gram and 4 sers of cotton seed daily.

At Dharwar, the most careful ryots supplied their cattle with 3 to 4 lbs. of a mixture of cake and gram per day while at work. The gram was usually the refuse from the threshing-floor. They wisely let the food down to the "grass-level" when the animals are not working, saying extra food at that time is no good. Dry fodder is in this district mostly straw from the Jowárí crop.

[1] Colonel Dods tells me he has often seen cows drunk from the effect of eating the refuse of the stills.

[2] Here 800 sers or 500 lbs. or 20 maunds = 1 candy, value Rs. 8 to Rs. 10 if of ground-nut cake.

In good cotton districts, cattle are usually carefully attended to and well fed. Cotton seed, from which the fibre has been removed, is given to them without any preparation or attempt to remove the husk or the very considerable amount of indigestible cotton still adhering to it. The large amount of oil and the natural moisture of the seed make it more digestible than either the decorticated or undecorticated cake with which we are familiar; consequently, large quantities can be taken by an animal without injurious results.

Bhusa is the name given to straw in the finely broken-up or champed condition in which it exists when it is removed from the threshing-floor or from under the feet of the bullocks used for treading out the grain. The hard and dry straws of India are much improved in mechanical condition as fodder through being thoroughly broken down by trampling. They have quite a soft and palatable feeling resembling the chaff of oats, and I have no doubt they are more digestible. This is shown by the decided preference which animals have for straw thus prepared as compared with long straw or that chaffed into short lengths, as in this country. The fact that the process of treading leaves the straw in a better condition as fodder than any other method of separating the grain is the most formidable objection to the introduction of the steam-thresher or British mill of any form.

Bhusa is pitted for future use in heaps in the field, and covered as we should cover turnips or potatoes, first with a layer of straw or rushes, and then a coating of clay is well plastered over all. When cattle are employed carting, they get their bhusa in a sheet suspended (so as to form a bag) by the four corners from the pole or shafts and the bottom of the cart. This is a simple and ingenious plan for preventing it, in its shortened and light, easily-scattered condition, from being lost or blown away by the wind.

Ages judged of by the Teeth.—As Indian cattle are long in coming to maturity, the times at which they "get" their teeth correspond more nearly to the times of late dentition in British cattle than to those of the early maturity strains. The milk teeth are cut before six months old; at one year they are fully up; at two years the two central permanent incisors are up; at three years the next pair, central lateral ones, are up; at four years the next pair, the outer laterals, are up; at four and a half years the corner incisors have come, although they may not be quite grown up, and the mouth is then said to be full. In the case of cattle that are well fed throughout, I noticed that the tendency was towards earlier dentition.

Other Indications of Age.—The ages of cattle between one, two, and three years old can usually be determined without examining the teeth, and when the indications in the matter of size are abnormal, by the shortness of the terminal tuft of hair on the *tail* in the younger animals. When cattle are over three years old, a *ring on the horn* is grown every subsequent year, and by these the age is easily calculated. The ring markings exist on males as well as on females, but they are not nearly so distinct on the males. The break between two rings seems to indicate an annual period of slow growth or cessation of growth, which, no doubt, corresponds to the period in which the food supply is at times restricted, as in countries where there is either a severe winter or a hot burning summer, and when the animal system becomes reduced. Wool in substance is closely allied to horn, and in the wool of sheep that have been starved for a time during a winter storm, a thin, weak part or ring forms at the point where the new and the old growths join. The poorer the sheep become the weaker will the weak part be. For what I take to be a parallel reason, the system of a cow bearing young or giving milk will be more reduced than that of a bullock under similar conditions as regards food, consequently the ring marks will be deeper each year she "carries" a calf. So faint is the ring at times in a year in which she bears no calf, that the break is overlooked by the inexperienced, and from this has arisen the fallacious impression that the number of rings on the horn correspond to the number of calves, not to the years of age.

Branding, or scoring the skin with a hot iron, is a common practice, especially in Madras and Ceylon. The hair is destroyed on the parts touched, so that lines or figures, with varying degrees of pretension towards the artistic, are left permanently on the hide. In Ceylon the operation is more widely practised and more neatly executed than in India. The markings assume great variety of shape; very frequently they are in long lines, more or less curved, along the sides. At times they form figures, as crosses, circles, etc., see Plates VII., IX. (*a*), XXII., XXIV., XXIX. (*a*), and XXXI. (*b*).

Branding is practised for a great variety of reasons besides the common one of forming a means of identification or a *mark* of ownership. It is thought to be *ornamental*. It is most frequently practised to destroy the young *horns*,[1] as a *preventive of disease*, or as a *remedy* for disease or injury; for example, when an animal is not thriving, and the hair is "staring" (when to give a better supply of food would often be a more rational treatment), or in cases of rheumatism, sprained muscles, or broken legs. It is also resorted to in cases of *barrenness* in cows. A circle is described on the body, enclosing well within its periphery the root of the tail, or, in other words, the rump, and external organs of generation. The *bad luck* which is understood to be associated with a swirl of the hair on the line of the back bone, on the chest, or other part of the body, is supposed to be undone by obliterating the "uncanny" mark with a hot iron. The practice seems to be a cruel one, in cases where the actual cautery is not neces-

[1] See Plate XXV.

sary, as a remedy for disease or injury, being frequently carelessly performed, and sometimes leaving raw red flesh marks, to feast the flies so abundant in the hot climate. I judge from the fact that it is adopted only within certain areas, that the full extent to which it is carried in Madras and Ceylon is unnecessary. Some careful ryots anoint the wounds with "till" oil, to keep off flies and soften the tender parts, thereby mitigating the discomfort.

Bulls.[1]—It is not the custom, as a rule, to work bulls, consequently the effects upon them are not so widely or so well known. It is understood that if a bull is worked while he is in lean condition, he will not breed, or rather he will not attempt it. I believe, however, that if bulls are well fed, they might be safely and even advantageously worked during the busy season, if they had immunity from work at the period when they were required for breeding purposes. This conclusion is arrived at from a knowledge of the fact that over-fat bulls in England are brought into breeding form by working in a plough. The refusal of a bull to follow the natural instincts of breeding, either in the case of his being too lean or over fat, is essentially a matter of condition, not of constitution.

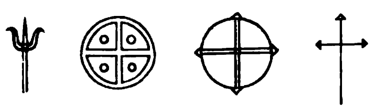
Bulling.—Natives have a practice of tying a cow to a tree if she refuses to stand to the bull, so that she may be practically raped. At first this may be thought a cruel, if not a criminal practice. Although somewhat rough, it would appear that the successful issue justifies the means. With a nervous animal it is necessary on rare occasions to follow this course among our own cattle, when it is known that she is in season.

In the cases which came under my own observation in India, the cattle tied up had been driven a considerable distance to the bull, and they had while on the journey gone off heat, or rather owing to the extra exertion of

[1] The word is used in the proper sense, and is not understood to include bullocks, as is usually the case in India.

travelling had lost the instinctive desire for the male. This is quite a natural consequence in a temperate climate, and it is even more likely to occur in the heat of India. Had those cows remained quietly at home, and had the bull been taken to them, the contact would most probably have taken place naturally at the same time. It is a fact that the instinctive desire becomes weakened before the periodical activity of the organs of generation is past, and that an animal of the lower orders is capable of conceiving for a time after the desire to mate has disappeared. In the case of restless and excitable females, it would seem that the chances of conception after contact with the male are then actually increased.

Brahmani or Sacred Bulls are animals that have been dedicated to the gods. In most districts they are branded with figures emblematical of the gods *Siva* and *Vishna*. On one hip may be imprinted a *trident* or a figure of a cross, with triangle or spear-head-like terminations to the three upper limbs. On the other hip a *discus*, somewhat like the above, but with a circle in addition touching the four barbs. The two figures described are shown on the right of the accompanying electro print, and were seen by the



Brands on Sacred Bulls.

author at Jessor. The two figures on the left were copied from brand markings common in Gujerat.[1]

A bull calf is selected, and let loose at the death of a

[1] Sir George Birdwood, who has made a special study of Indian art, symbols, and cognate subjects, and whose book on "The Industrial Arts of India" touches on this question, says: 'What stamps the sacred oxen bear on their flanks depends on the god to which they are dedicated. The down-pointed triangle ∇, expressing (female) reproduction, is the mark of Vishna, and is used by Vaishnavas. The up-pointed one Δ, symbolizing generation (male),

person of importance, to roam without interference wherever he pleases, and naturally much damage is done to crops in the field when he chances to wander in that direction. He, as a rule, however, remains about the village, being a sort of general pet, receiving contributions of food from all and sundry, and helping himself in the bazaars to what he may require in addition to such gifts.

Though, upon the whole, these bulls must have been, when in large numbers, a serious tax upon the community, still they were not void of usefulness. No one required to keep a bull specially for breeding purposes; and as good calves were selected, no doubt sacred bulls have had a considerable influence in upholding the quality of Indian cattle. In such districts as Naldanga, stray cattle are impounded by the police, and sold, if not claimed within a fortnight, for Rs. 3 or Rs. 4, to be taken to be killed in some large centre like Calcutta, or they may be castrated and broken in to work. In such places the inhabitants report a decrease in the numbers of cattle, owing to the difficulty of securing bulls when the cows come in season. Complaints also were frequently made of the decrease of cattle, on account of the numbers, in addition to sacred bulls, sent to be killed for beef.

Castration, according to Indian practice, is said to be cruel as compared with the methods adopted in this country, yet under the climatic conditions it would result in even greater cruelty to substitute our home system for that of India. The common method—which I admit to

is the mark of Siva and of all Saivas. The two united in copulation are the mark of the supreme godhead Brahma. Siva and Vishna are also indicated by many other marks and symbols. The wheat, the conch-shell, the lotus flower, are all Vaishnava marks; the trident, the hour-glass-like drum (tom-tom), are Saiva. It is nearly always Saiva and Vaishnava cattle which go about, and, sometimes in Gujerat, Jaina, *i.e.*, modern Buddhists who have adopted most of the Vaishnava marks in addition to the Buddhist swastika 卐, which is a form of sun-wheat. The *Journal of the Royal Asiatic Society*, Old Series, vol. vi. p. 454, vol. xviii. p. 392, also treats of sacred marks.

be painful during the time of the operation, though, if properly performed, it is not attended with serious after-consequences—is that of breaking the testicles, while they are held in position by large wooden "clams," or lie on something solid, by means of a wooden mallet or a stone, and when completely ruptured working them well with the hands to reduce them to a pulpy condition. If this is thoroughly executed, they swell for a few days, but afterwards gradually become absorbed and disappear. If the operation has been imperfectly carried out, a distorted lump remains within the scrotum, giving somewhat the appearance present in a case of *scirrhous* cord in a horse. To merely rupture the seminal ducts seems to have the desired effect, and to be attended with much less suffering to the animal.[1]

The point of greatest importance to note in the practice of castration, as carried out in India, is that the skin is left intact. The injurious consequences resulting from leaving an open suppurating sore in a hot climate have no doubt had a powerful influence in establishing the practices described. The flies and microbes of putrefaction which

[1] The following is condensed from a description written by A. Stormont regarding the district in Khándesh near to the Bhadgám Government Farm. "Castration of cattle is usually performed by the *Mang* caste, that of horses by *Thillars*, of sheep and goats by *Dhanagars*, and of pigs by *Wuddurs* and *Kaikaris*. *Kutne* is the special name given to the method practised on cattle. It is performed without cutting the skin. It is said not to succeed in the case of horses, sheep, or pigs, and consequently these are cut with a knife. The most suitable time of year for Kutne is soon after the rains, but not on a Friday, as it would be unlucky, because it was on Friday that Mahadev rode his bull."

"After the animal is cast and secured, all ticks (*Acari*) are carefully removed from about the scrotum, and this is drawn tightly over a smooth stick placed under the neck of the scrotum—the polished end of a yoke suffices for the purpose. The part is then well anointed with a mixture of fresh butter and turmeric powder, and heavily rubbed with the palm for a few minutes to benumb the seminal ducts. A few smart taps with a rounded smooth stone finishes the process. It is so exceedingly simple and free from injurious results, that an animal may go to work again within a few days."

would naturally congregate on the wounded surfaces, if the animal were not housed and guarded, would become a fruitful source of loss to the owner, besides causing misery and suffering to the creatures. Apart from the injurious influences of the climate, there is additional risk in removing the testicles of a male which has so nearly reached maturity as Indian cattle have before castration, so it is just possible that under the circumstances the pounding system is safer than that of excision for reasons altogether distinct from those associated with climate.

The effect of castration, if carried out early in life, is to reduce the tendency in all animals to develop masculine characters—such as the massive neck and prominent crest of the entire horse. The emasculated male assumes more or less the external form of the female, and in cattle as well as in the human species the voice is affected. In Indian cattle early castration reduces the size of the neck—makes it thin and weak like that of a cow. Neither the hump nor the dewlap attain to their natural dimensions, and even the colour, which in most breeds has a tendency to become darker as a bull approaches maturity, remains light like that of the female and young bull. The shape and strength of the horns are not so much altered as in the case of British cattle when early castrated; yet the horns do become more irregular, as may be seen from Plate IV. when compared with Plates I., II., and III.

In addition to the special points referred to, the whole substance of the frame is weakened, and the growth is retarded, although when maturity is reached, I do not believe that the height is the less in consequence, and it might even be greater in some cases.

So well do the natives know the effects of the operation on animals of different ages and at different stages of maturity, that they study the "ripeness" of their beasts with the greatest nicety.

If a bull has been well fed, and is in consequence well forward for his age—well developed—they castrate him at three years old, but not sooner under ordinary circumstances. A bull which had been poorly or moderately fed, as is usually the case, will not reach the proper stage of development till four years old, when six teeth are up; then the operation is performed. It is known that if animals are castrated too young (before four teeth are up), although by good feeding and treatment the hump and neck are large, their growth is not permanent, and the parts weaken and diminish too much in size. It is found again, on the other hand, that if castration is delayed till the constitution is completely set, as indicated by all the eight incisor teeth being well up at five years, the disposition of the animal is spoiled by the operation, it becomes sluggish and lazy, and wants the mettle necessary to make a good working bullock. This tendency is not confined to cattle alone, but must be familiar to most observers of nature in the cases of dogs and cats which have been fully matured before being emasculated.

The listlessness is usually attributed to fat, but it is much more likely that the fat accumulates in virtue of the laziness and want of exercise. We know for a fact, at least, that many corpulent men are at the same time most active and energetic in spite of their fatness.

The want of a proper knowledge of these facts has led European residents in India into the very serious blunder of castrating, or attempting to castrate, the inferior male cattle at an early age to prevent them breeding.

It is thought to be next to impossible, in the ordinary system of herding village cattle, to keep back the young active and growing males, which are in consequence of these qualities likely to become the most prominent stock getters. Separating them into a herd by themselves, and pasturing them apart, is no doubt the effectual plan, and might be practised most successfully on large cattle farms;

but with village herds, unless under favourable circumstances, which are not now common, it is impracticable on account of the intermixture of all classes as they return at night to their respective owners.

An Alternative for Early Castration.—It may be broadly stated, that natives (with exceptions) do not attempt to keep up the standard of their breeds of cattle by mating their animals judiciously, but leave it to chance. This is rather peculiar, in view of the fact that great care is generally bestowed on the mating of buffaloes; and although young bulls are not restricted in their attentions to females of their own species, they are completely prevented, by an extremely simple contrivance, from "jumping" the female buffaloes. Buffaloes are peculiar in the respect that they are slower than cattle in moving out of the way of anything approaching; the consequence is that as the mixed droves of cattle and buffaloes are passing to their grazing ground, and particularly at times when they are crowded closely together, the young bulls mount the female buffaloes. The act of copulation does not lead up to a cross between the species, which is impossible, but it very frequently results in setting up irritation, which ends in abortion in the case of the buffaloes carrying young.

The native preventive method is to suspend a cloth of about 18 in. square by the middle, so that it doubles over and hangs down from a rope, which passes round the body of the young bull immediately behind the forelegs, to present a screen, which covers the posterior of the cow as he jumps upon her, so as to effectually prevent the smallest chance of injury in the direction indicated. The arrangement is free from producing evil consequences in the wearer. See Plate XIX. (*a*)—"The culprit!"

Hobbling.—To prevent cattle straying any great distance, and in lieu of fences, it is usual to tie up a foreleg or bind the forelegs, or a fore and hind leg together, or even the foreleg to the head, so as to temporarily restrict the power of locomotion, no doubt, however, greatly to the discomfort of the animal, especially when it is made to stand as well as walk on only three legs. A more humane method is to tie under the neck a stout 3-feet pole by one end in such a way that it passes between the forelegs, and drags the other end on the ground.

In the neighbourhood of villages, where poor and insufficient fences—often made of frail uprights through which animals could easily press—are erected round garden plots, it is usual to make each animal carry the effective part of the fence with him. A rope is tied round the neck, and from it is suspended a light pole 3 or 4 feet long, which is balanced by its middle. When a fence is approached, and when the head is passed through, the cross bar immediately comes into play, being supported in front of the breast in a proper position to check the advance. Most animals, even including pigs, are kept under control by what we might term a portable adjunct to the fences in their neighbourhood, which they in this manner are made to erect for themselves on every occasion of an attempted depredation.

Driving.—Bullocks are made to pull in India by means of a yoke, which is most frequently a rounded smooth stick laid on the neck in front of the hump, and fastened to a pole projecting forward from the cart and separating the cattle. In the case of "tracers" a rope is the only attachment to the load; and when going up hill, it is necessary to weight the yoke by hanging on something, such as a bag of grain, to keep it down. At times the native driver sits upon the yoke, which is then flattened on the upper side, so that he can retain his position. The weight keeps it from moving unnecessarily on the neck, and thereby chafing the skin, and producing sores. Two bullocks yoked to a cart are for the most part driven by a man sitting astride the pole, and urging them when necessary, by now and then touching their bellies with his toes, by his voice, by tickling them with his hand between the hind legs, or by means of a cane switch, or a light sharp-pointed stick, with which he goads them, usually near to the base of the hump. By too freely using this latter drastic remedy an open sore is sometimes made. Another cruel practice is twisting and doubling the tail at the most flexible part immediately above the terminal tuft of hair, so that the joints are dislocated and the tail becomes knotted and ungainly; undoubtedly this must result in much suffering to the animal. It is all the less excusable as it is under ordinary circumstances quite unnecessary. If the driver puts his hand on the rump, it is usually sufficient to accelerate the motion of the beast.

The bridle consists of a single endless rope, which passes round behind the horns, down each cheek, and through a hole pierced in the thin cartilage forming the wall between the orifices of the nostrils—at the place, in short, where the nose-ring of a bull passes. The *nose-rope* fulfils the function of a nose-ring, and gives the driver great command over his cattle.

The reins consist of a single rope, with the ends attached to the head ropes of the two animals yoked together, at a point in each immediately behind the base of the horns. At times, when the cattle are not desired to feed, a muzzle, consisting of a small, open net-bag, is substituted for the "branks-like" nose or head-rope.

Though condemning in the most unqualified terms unnecessary *cruelty* to trotting bullocks, yet it is positively necessary that the driver should secure and retain the mastery. I had some experience in Ceylon of a good example of "sparing the rod and spoiling the child." A gentleman sent his single bullock bandy to the railway station with a clerical friend. The bullock had a very strong aversion to the smell from a slaughter-house, as cattle frequently have. On this occasion he made the customary objection to passing a place of the sort by the way, as a horse with an imperfect vision will at times do at a pool of water on the road. The *padri* would not allow the driver to use the necessary rather severe means of persuasion, and the result was the bullock for the future refused to pass any slaughter-house until it had been subjected to marked cruelty, and until it had kicked its limbs into a tired and almost unrecognisable condition against the bottom of the cart.

Native Drivers are frequently very skilful in their art, and go thundering along (the sound of a wooden cart without springs is not unlike miniature thunder) at the rate of 6 or 7, or even 8 miles an hour. In villages where the streets are narrow and crowded, they turn corners and make numerous hair-breadth escapes with rarely a casualty. They take much pride in the appearance of their animals, which they deck in holiday times with sheets of gaudy cloth, and hang bells and chains about the head and neck. See Plate XXVI. (*b*). At times, hollow bangles of some common metal are placed round the shanks of the fore-legs; little balls within these make them jingle like bells as the animal walks. Bangles may also consist of wire coiled round in artistic fashion. These are generally considered to be ornaments. In other cases they are looked upon as charms to ward off the evil eye. See Plate XIII. (*b*).

It is a common native practice, by way of ornament, to gild or paint the horns a most objectionable red, or possibly a blue colour. At times the painting is carried on to the skin or hair in different parts of the body, which is even more objectionable.

Horns are very frequently capped by an ornamental brass tip. See Plate XXIII.

The Panjrapol is a sort of half-refuge, half-hospital, in which diseased, injured, or stray animals may find shelter. I have heard of as many as 5000 four-footed beasts of one kind and another being congregated in one of those places.

Although the intention held by their native supporters regarding them is good, it is easily seen that it must be quite impossible to carry out a proper system of feeding and management on a very extensive scale in times of scarcity when there is no one personally interested. It is not to be denied that these institutions do not always convey to one the idea of either comfort or plenty to the inmates. I have even heard them described as charnel houses of misery and corruption. The following account is from the *Ahmedabad Gazette:* "In this one district there are eleven such homes, costing from Rs. 600 to Rs. 15,000 per annum. All living things are received freely without fee. The inmates are tended by a staff of servants. Sometimes fields are rented for the grazing of the cattle, but usually they graze on the common village pasture lands or 'gaucharans.' Besides accommodation for four-footed animals and birds, every home contains at least one insect room. In Ahmedabad this is filled chiefly by a servant, whose business it is in the rainy season, when putrid matter is plentiful, to carry a bag round the street for the collection of maggots and other small vermin. A little grain for their subsistence is thrown into the room, and at the end of each year a new room is opened. The old room is closed for ten or twelve years, and after that, as all life is supposed to have ceased, its contents are cleared out and sold as manure. Sometimes the agents of the Panjrapol go to auctions to outbid the butchers, and take the animals for sale to the home; but this is rather expensive, and as a rule the animals are those brought from the streets, or sent by those who can get no more work for them."

Another account from the native states of Gujerat says, referring to Pethapur: "There is a home for cows, buffaloes, bullocks, and horses. Some of them are maimed, diseased, and some are healthy. They are sent to the hospital, either because their masters wish them to pass a pleasant old age, or because they have become useless to them. Animals born in the hospital belong to the hospital. Those that are of any use are either set to work or sold. The animals are well fed on grass, hay, pulse, and millet,—the healthy ones grazing during the day with the rest of the village cattle. The home is under the management of the "mahajun," or trade guild, who support it at a yearly cost of about Rs. 900. Any one sending an animal has to pay something either in money or grain, but the rates are not fixed. All animals except those attacked with contagious diseases are admitted into the hospital. When they are diseased, efforts are made to cure them. When an animal dies, its carcase is taken away by the tanners. A special part of the home is used as a worm-room where the vermin that infest grain are kept. Grain attacked by vermin is laid on a cloth, and spread in the sun. As the grain grows hot, the animals leave it and, sticking to the cloth, are caught, put in a vessel, and carried off to the worm-house."

CHAPTER V.—DUNG.

Fuel—Manure—Fermentation of Manure—Rothamsted Experiments—Uses of Dung peculiar to India—Storing—Excuse for Carelessness—Nitrification—Conclusion.

DUNG.

FUEL.—The dung of cattle is, when dried, the most important fuel used by the native population in India. It is plastered, while fresh and yet moist, against the wall of a house or the trunk of a tree, and left to dry; or it may be mixed with refuse straw to hold it together, and formed into thin and rounded slabs of about 9 inches broad and between 1 and 2 inches thick, and set up to bake hard in the sun. These may be seen in large quantities carried on the head to market by the female population in districts near large towns. As fuel, dung does not throw out sparks like dry burning wood to endanger the safety of the house, and it has, in addition, the valuable property of remaining in a smouldering condition for a long time, enabling the inmates of the house to leave the food to cook while they are at work in the fields. While burning, there is no offensive smell noticeable. I remarked the wonderful difference in this respect as compared with my yet vivid recollection of the overpowering and offensive odour exhaling from the cow-dung fuel of the Mennonite villagers in Manitoba, which I had visited about eight years before. The more perfect method of drying must have had much influence in determining its character in this respect, and also in improving its value as a fuel. It is not unusual to see a party of workers with a piece of dry dung cake smouldering in a corner of the field ready to light the ever-present workman's companion—the "hubble-bubble." Much objection has been taken by Europeans (1) to the so-called "wastefulness" exhibited in burning valuable manure, and (2) to the careless manner of storing it when it is not all burnt. As regards the latter, natives, although not to be encouraged in their neglect, are certainly not more wasteful, considering their opportunities, than the average British farmer; and I must confess that, under the circumstances, taking everything into consideration, with *present conditions* the practice of using it for fuel is the correct one, and does not entail so much loss as the unskilled observer might imagine, while the comfort reaped is a great and indispensable boon to the people.

Manure.—Only the organic matter is lost; and it is quite possible that scientific experiment may yet show that all of the apparent loss is not real. Under the exceptional circumstances in which the material is burnt, it is possible that more than we imagine of the nitrogen is liberated in a useful form, and may be to a large extent brought back to the earth by rains. I think it will be admitted, after perusal of my remarks relating to the natural decay of dung, that it is yet an open question, and one which can only be decided by scientific research, including chemical analysis, whether the loss from combustion of dung as fuel is greater or less than that resulting from bad management in storing, combined with an inferior process of decay after it is put into the soil. The ash is usually preserved with care, and held in due estimation as manure. It must be remembered that the value of the organic matter of dung from poorly fed cattle, such as Indian cattle frequently are, is much below the value of British made manure; and I am not certain but that the ash is improved in physical character by its passage through the fire, at least as regards its rapidity of action. One very important point which I have not seen mentioned is, that dung stored in a climate such as India—unless very special precautions are taken to keep it sufficiently moist on the one hand, or from becoming too wet on the other—will not ferment properly.

Fermentation.—Dung requires not only to be a good material, containing rich manurial substances in a crude and often insoluble form to begin with, but it must be properly kept, to enable fermentation to do the work of preparing it for plant food. This would require special care and special knowledge where, at present in India, there is total ignorance. In the dry weather it dries up almost immediately, and in the rains it is soaked—consequently a proper fermentation cannot take place at either period.

The Rothamsted Experiments have shown us that some of the nitrogen—by far the most valuable ingredient in dung—most probably escapes in the form of worthless, free nitrogen.[1] The question as to how much more nitrogen escapes in the free and valueless condition when manure is properly fermenting than when it is not doing so, is one which only chemical experiments can solve; but it is a question which, if answered, would have a bearing of vast importance in the future of Indian agriculture.[2] The

[1] Since the above was written my remarks have been strongly corroborated and my ideas relating to the decay of dung extended in a book—*The Rothamsted Experiments*, by Professor Fream, B.Sc. Lond. Published by Cox, *The Field* office. It gives a concise and reliable account of the elaborate field experiments which have been conducted with so much care and ability for over forty years by Sir J. B. Lawes and Dr Gilbert, and which, when made known, will be found invaluable to the student of Nature alike in India and England. Fream says, page 197—"Neither with the wheat, the barley, nor the mixed (pasture) herbage was there more than from 10 to 15 per cent. of the nitrogen supplied in the farmyard manure, recovered in the increase of crop during the (twenty) years of its application." After pointing out (page 201) that there is a loss of nitrogen from land by under drainage, he says—"A considerable further loss is probably due to decomposition of the nitrogenous organic matter within the soil and evolution as free nitrogen."

[2] In the *Journal of the Chemical Society* (Feb. 1888), No. ccciii. page 185,

loss of organic matter, which is at worst minimized by the extra supply of nitrogen from the air,—if my theory relating to this matter be correct,—is so far counterbalanced by an increase of the total ash residue resulting from manure gathered in roadways and waste places, which, unless primarily for fuel purposes, would not have been collected.

Uses peculiar to India.—Dung is of all *Ráb*[1] *materials* the most valuable. It is also extensively used by the poorer classes of natives in *cleaning* their houses, to plaster over the floors and walls, and on the insides, outsides, and tops of their corn bins, to prevent lice, or insects which would attack their grain, finding a harbour. The sameness of the walls is broken at times by markings, artistically made, while the coating of dung is yet wet, in the same manner as the grain of oak wood is imitated by painters. In sandy or porous soils it is plastered on the sides and bottoms of irrigation channels to make them retain water. It is also spread on the outsides of mud-built houses to keep out the damp.

Storing.—It is the exception, not the rule, to find dung stored in pits sunk in the ground and the moisture properly regulated.

Excuse for Carelessness.—In some parts it is neglected and wasted, because it is not safe to apply fresh dung to the roots of plants, as it is eaten by beetles and grubs,

under the heading "The Development of Free Nitrogen in Putrefaction and Nitrification," it is stated that in the case of certain experiments, which lasted twelve months, "there was a loss of 15 per cent. of the nitrogen," and further, "that although putrefaction pure and simple does not cause the disengagement of gaseous nitrogen, certain processes of a secondary nature may perhaps do so." A number of possible causes are suggested. Among others, "the action of free nitric acid on nitrogenous organic compounds." In another series of experiments a loss of 9 to 10 per cent. of nitrogen accompanied the nitrification process. The limit of interest in this question could not be reached without a determination of the greatest possible loss occurring under conditions natural to the soils of India.

[1] See an explanation of ráb at the end of rice cultivation.

which consume or destroy the roots of the crops also; or it is kept so wet after being applied to the soil that it refuses to decay naturally.

Nitrification.—The conditions seem to be such that the germs which form the active agents in the nitrification of soils and decaying organic matter do not thrive. No doubt decay goes on, but the active agents at work are not the useful agents; and it would appear that the nitrogen, which under more favourable circumstances might have been converted into the most valuable plant food, goes off probably in the valueless form of free nitrogen.

Those who are totally ignorant of the life-history of microbes as affecting the processes of fermentation or decay, may find some difficulty in accepting the fact, that the best farmyard manure can be placed under conditions which will render it practically worthless. Even in England, where climatic conditions do not approach to the same extremes as in India, manure can be seriously injured in the pit. By allowing the temperature resulting from fermentation to rise too high, the mass becomes "fire-fanged" and worthless.

In India, when dung is thrown into heaps from the cattle sheds in the dry weather, it gets into a fine pulverulent condition like the bin of dust from a peat stack, and is then termed *joke* in Gujarát. The fermentation of which I spoke is also impossible when it is in this condition.

In conclusion, it may be gathered from what I have stated that the difficulties of preserving and also applying dung as manure in India surpass anything of which we have practical experience in this country; and further, that the loss from carelessness and want of knowledge must be very great in the aggregate. It shows us that the loss resulting from the use of dung as fuel may, from the point of view of its reduced value as manure under certain circumstances, be considered trifling in comparison with the loss which would take place if dung were burnt in this country.

A study of the nature and properties of dung in India must of necessity be extremely complicated; but seeing that dung is practically the sole universal manure available for land under agricultural cultivation, it assumes an importance which certainly marks it out as deserving of more attention than it receives from the ruling authorities.

CHAPTER VI.—GOVERNMENT CATTLE.

Artillery and Army Transport Bullocks—Their Management, Age, and Condidition—In the Bolon Pass—Experimental March—Assisted by Elephants—Trial March--Food of Bullocks at Allahabad—Quality of Cattle—Changes necessary: (1), Average Age Reduced; (2), Cattle Trained to Work—Unsuccessful Attempts; (3), System of Feeding Reformed—Functions of Food in the Animal Economy—Government Cattle Farm, Hissar — Management — The Breeding Stock — Shoeing, and how accomplished.

ARTILLERY AND ARMY TRANSPORT BULLOCKS.

MANAGEMENT.—In no description of cattle which I examined in India is there to be seen, more than among the Government bullocks, the evil consequences, inefficiency, and actual loss which attend the want of a proper rational system of management, based upon a scientific as well as a practical knowledge of the habits and requirements of the animals under consideration. I have not a word except of praise for the energy and interest exhibited in the public services by the officers in charge of the departments visited; but I cannot too severely condemn the system which they are under orders to carry out. I found, for example, at Allahabad, where there were over 600 bullocks in the cantonment lines, that a very large proportion of these, from various causes, were totally unfit for active military service. I intentionally withhold my opinion as to what was the percentage of this class, so that I may not raise unnecessary prejudice in the minds of the uninitiated against my detailed remarks.

More than half of the bullocks were over ten years of age, ranging up to seventeen years. Many of the larger ones, used for artillery purposes, were bred or selected with their parts altogether out of proportion, and such as to be really incompatible with hard work or endurance. Height is an immense disadvantage to a bullock if it does not carry a proportionate share of strength with it. Though some of the large specimens were in good condition as regards fat, yet there was a decided want of *muscular development* of a hard and useful sort. The muscles had got flabby or atrophied from want of exercise. Any one who has gone in for athletics and for hard training of wind and limb will fully understand me when I say, that a bullock kept dawdling with a half empty military cart along a few miles of level road per day, and never employed at real good hard work, must be most cruelly disappointing when put to a severe test, such as a march of a month's duration across country, in Afghanistan, on short rations.

A bullock does not come into the world a born worker. It has got to learn to work quite as much as a blacksmith has got to learn to shoe a horse; and like the muscles of the blacksmith's arms, the muscles of the bullock must be developed by exercise, and kept in training and good order by frequent practice extending over years, and going back to a time when the natural youthful growth of the frame was not fully completed. The part which bears the burden, in this case the neck, must be well tanned by years of patient labour to prevent abrasion of the skin (yoke-gall), swelling, and abscesses, which result when animals are rushed into full work without the necessary preparation for it.

A distinct parallel is to be seen in the soft and easily blistered condition of the palm of a man who holds a pen in an office, as compared with that of the hand which daily wields a forge hammer, or that of the "horny-handed son of husbandry" who holds the plough.

Having formed my opinions, I had no difficulty in finding evidence as to actual results confirmatory of my views.

An officer of high rank in the Military Department told me that he had collected for him, towards the end of 1878, about 300 country bullocks from the plough (ordinary work) to draw a heavy field battery, and that during the severe march up the Bolon Pass to Kandahar, the country cattle, although doing exactly the same work as the large Government bullocks in another battery, lost only twenty of their number, or about one-fifth of the loss sustained by the Government cattle.

It must be remembered, too, that it is not the best class of local cattle that are to be picked up in a short time in the market, so that in reality the figures might not indicate the full extent of the inferiority of the large bullocks.

The following quotations from a "Journal of Experimental March of No. 4 (Heavy) Battery, 1st Brigade, Welsh Division, Royal Artillery, from 6th January to 28th January 1885,"[1] supply very valuable evidence in support of what I have said regarding the untrained condition of the military bullocks.

It is necessary to explain that "the route was generally a bandy (cart) track, *usually good going*, but with occasional sandy nullahs to cross," and other minor difficulties. *The distance* covered was 367 miles, or an average of say 17½ miles daily. On good roads the *pace* was 3 miles an hour. One gun and one howitzer were in elephant draught. So far as I can make out from the Report, which is not very explicit in this particular, 266 bullocks started: 238 of these were in draught, and 16 had to be changed on account of lameness and neck galls. *The elephants*[2] were used to help the cattle in cases of difficulty, and did

[1] The Report is dated Secunderabad, 26th Feb. 1885, and is signed by Major J. Charles.

[2] The fact that it is necessary to have elephants to help the cattle in cases of great difficulty is no excuse for the inefficiency of cattle when the difficulties are not great.

excellent work throughout, "and their condition generally on arriving in cantonments was exactly the same as when they started." Their value may be gathered from what follows. *On 8th Jany.*—"The battery was delayed for about an hour at a sandy nullah near Mutaredpully." "The bullocks, in many instances, refused to work the moment the sand got deep, and *did not try* to pull." "Elephants had to be used for several of the carriages, either pulling or shoving behind." "The sand extended for about 120 yards!" *Jany. 9th.*—"Delayed at Moosa (120 yards of sand) for one hour and twenty minutes." "In some cases the bullocks made *no attempt whatever* to pull." *Jany. 19.*—Again at the Moosa River, "Several of the carriages got over the sand unaided, but in others elephants had to be used—the bullocks in several instances refusing to pull." Later on the same day it is recorded, that "on several occasions elephants had to be used, all but one pair of bullocks being taken out." This last is a most instructive statement, if it is intended to be read as it is written, as it shows the utter incapacity of almost the whole of the cattle on the 14th day of steady work, while, at the same time, it proves that whatever the difficulties were, they were not too great to be overcome in the case of at least one pair of bullocks. It would be interesting to know if the latter derived their willingness and ability to pull through being previously trained or broken to work. During the remainder of the march, although the bullocks are reported to have pulled very much better, yet elephants had to be resorted to in all cases of difficulty.

A survey of the whole Report shows clearly, that had the bullocks alone been depended upon, the trial march could not have been performed, and even with the help of elephants the results, under circumstances which could not be called unfavourable, were most unsatisfactory,[1] with

[1] This opinion I form from the Report itself, in spite of the fact that the trial was claimed as a great success.

one exception, viz., that there was a net saving of about Rs. 160, on account of the cost of commissariat supplies for the men and animals being cheaper by the way than if they had remained in camp. It is important to take notice of the latter fact, because it shows there is no pecuniary difficulty in the way of adding trial marches at suitable periods of the year to the means of systematic training of military cattle.

From a "Translation[1] of a Report by a driver of the 'Cauvery Pauck Depot' to the Assistant Commissary-General, Hoonsoor," we learn that a trial march with twelve bullocks drawing loads from Saint Thomas Mount to Cuddapah and back was a complete failure, on account of the exhaustion of the animals and the sore necks they contracted early on the way. The authorities were either culpably ignorant of the proper load of a bullock, or the cattle were palpably unfit for work. I give the preference to the latter alternative, as the drivers could, by allowing more time on the road, have overcome the difficulty of a little extra weight.

The large artillery bullocks at Allahabad got 6 lbs. of gram daily, and the smaller army transport cattle 4 lbs. a day all the year round. In ordinary seasons they have green cut grass from the middle of August to the middle of October, after this hay up to the 15th of June, and for the remainder of the year bhusa. When grass is not plentiful they have bhusa half the time.

By giving nothing in addition to bulky fodder except grass, all the enormous advantages gained by supplying a judicious *mixture* of concentrated food to an animal is lost. The result, even at a greater cost, is unsatisfactory and disappointing. Again, cattle if not trained to eat other foods will generally refuse them for a time at least, and when gram is not to be had will seriously suffer in consequence. With purely gram-fed cattle, it becomes necessary to carry gram when passing through a country which

[1] Kindly supplied by Col. Hay.

does not supply it, although there might be abundance of local food if it could only be made use of. It is a most valuable quality in either man or beast, when "roughing it," to be able to eat heartily of anything suitable for food that the locality presents. So much time is saved, and so much carrying power is left available for other purposes, or for lowering the average load. These remarks apply also to horses, mules, or other beasts of burden.

I have repeatedly heard officers complain that the animals under their charge would not eat this or that sort of grain, although it was quite palatable and largely used locally by the natives in feeding their own stock. The idea that animals will not eat good palatable food, if a proper method is employed to teach them, is fully described by the useful slang expression "bosh." It is simply a matter of training, and is, in my humble opinion, one of the most important points in which all animals in the military service should be thoroughly schooled. Some of the small hard pulses may require treatment, as by bruising or bursting, to prevent their being bolted and passed without adding to the available food during its passage through the alimentary canal, but these are merely matters of detail which can be surmounted with little difficulty.

The class of cattle which had recently come into the lines was, without question, distinctly superior to that which had been imported a few years before. The best were crosses between the Mysore bull and one or other of the larger and softer breeds of North-Western India. Though admitting all this, and further, that the best of them were really fine cattle, still there was a "tail" of beasts which was anything but satisfactory, or what it ought to be or might be.

Among the changes which are necessary, and which I should most strongly advocate, are these,—No animal should be retained after he is twelve years old. The worst of each year's lot should be draughted at ten years, a number might go at eleven years, and all should, without exception, be cleared off at twelve years of age. No doubt bullocks can live and do work till they are many years older than twelve, but large bullocks especially are at that age past their best for the severe strain which military bullocks should be at all times equal to on the shortest notice. A visible sign of the incipient decay of constitution, which, if judged of by the external appearance, might easily evade detection, is the loosening or actual loss of incisor teeth about this period. Besides adding to the efficiency of the whole by importing a much greater supply of fresh blood from which to select the best, by judiciously breeding and selling annually from all ages of the cattle, the undertaking would have the recommendation of being remunerative. Many of the wealthier natives, although they do not now buy the cattle that are sold after being worn out, would be glad to give a good price for well-conditioned "cast" cattle of ten or twelve years of age, as they would yet be good for a number of years of work such as would be required of them.

The second, and perhaps the most urgent matter demanding reform is that relating to the muscular condition of the cattle to their training to real work, and the keeping of them in a state which would reflect credit upon the department if they were suddenly called upon to go into active service sufficient to try their qualities to the utmost.

It is an expensive luxury to breed and maintain for a long period of years a large number of cattle, which prove to be lamentably deficient when turned out for service. But the more serious feature of the case is that they, in a time of urgency, might be trusted to perform work which they are unequal to, and thereby land an army in disastrous complications.

It is the duty of Government to spend a considerable sum of money in the working or training of their bullocks, if it is necessary to keep them at all. There can be no more satisfaction in the cattle when put to work, kept as they are at present, than there would be in attempting to run an untrained and half-broken colt to win a race.

It was strange to find, that even the moderate opportunities available on the Government grass farm at Allahabad for the accomplishment of this important object were not taken advantage of,—cattle were actually hired from the cultivators around to do the work of the farm at busy seasons, while the greater part of 600 Government bullocks were literally wasting in idleness. Of course, no doubt, it will be said the bullocks were employed, but common-sense alone, without any special knowledge of the case, is quite sufficient to lead one who thinks to see that the number must be small indeed which can really find constant employment in a military station. If they are employed now, it would be interesting to know if they could be spared from their present work to go into action should war break out!

From a Report of the Allahabad Farm, written by Major Yaldwyn, from its opening in 1882 till June 1887, it would appear that unsuccessful efforts had been made in 1885–86, and again in 1886–87, to get the transport bullocks to help on the farm.[1] The reasons given for the failure are by no means satisfactory, and practically mean that something akin to insubordination on the part of the men employed was winked at.

Not only might the present work of the farm be done by the military cattle, but it might be judicious, for the purpose of increasing this work, to grow crops on parts of the farm not under cultivation, to help to produce food. I do not mean to imply that Government could farm to

[1] "An attempt made, 1885–86, to get the transport animals to work in ploughs ended in bad results, for the ploughs, though very strongly made, were soon broken to pieces by the transport attendants, and it was found impossible to get them to work." In 1886–87, "another attempt was made, but in vain. The bullocks would work well enough if the men were willing, but the latter were lazy and indifferent."

profit while growing grain under ordinary circumstances, as I think that may be taken as an acknowledged impossibility, but with land of their own, and bullock labour supplied free of cost (as the food of the cattle would be charged as at present against the military department), it ought to be possible to make ends meet without further outlay, and the benefit conferred upon the cattle in the form of increased efficiency would be simply marvellous.

While bullocks are young they are light on their limbs, and they also profit most by regular work. If the farm did not supply enough work to employ the fully-broken and older cattle sufficiently to keep them in good training, there would be little difficulty in placing a number of them under the care of reliable natives, or of municipal authorities in need of bullocks for their scavenger-carts, where they would be fed free in return for their labour, and from whom they could be recalled in the pink of condition at a moment's notice, if required for Government service, which would be but seldom.

The available supply of cattle might be further increased by selling the "casts" a year before they became unfit for active service, with the proviso that, if wanted within twelve months, they could be taken back by Government at a fixed price. There could be no practical difficulty or reasonable objection to the scheme with the prevailing practice of branding marks on all Government bullocks. It would be simply carrying the English system of army reserves into the cattle department of the services.

In the matter of food, the concentrated portion should be a well-arranged *mixture* of "pulse" seeds, "oil" seeds or oil cakes, and grains, which abound in variety in India. One leading influence directing the proportions of substances in its composition should be the prices of the ingredients. To give the same amount of concentrated food all the year round is an objectionable and an unnatural practice. It is impossible to keep an animal steadily at the same degree of perfection at all times by giving the same quality and quantity of food. Nature, by her alternation of seasons—summer and winter in this country, and wet and dry periods in India—provides a time of plenty and a time of scarcity. Our domestic animals, including cattle, are the children of Nature, although altered in some minor respects by their association with civilisation. They have not been long enough under control to eliminate the natural tendency in the constitution to become periodically reduced, and from this lower point to start afresh in the upward direction. It is only when the quantities of food are kept on the increase that an improving tendency can be maintained for any appreciable length of time, and this, even at the best, is not without very considerable variation. To continue the same amount of food at all seasons is an attempt to force the hand of Nature in an impossible direction. It is best to accept the inevitable, and once a year let down the food supply to Nature's level. What we may term the "grass-level" is the most economical and most suitable in every respect. At the season when there is a plentiful supply of good grass, all artificial foods should be discontinued, unless when work has to be done; then an amount of additional food must be supplied to make up for the extra expenditure of energy and waste of tissue. Under this treatment, the system would get annually relieved of the impurities which accumulate under prolonged artificial conditions, and the supply of rich food given thereafter would exercise a greater and better influence. It is also an acknowledged fact that highly-fed animals live faster than those more moderately nourished; they come to maturity more quickly, but also decay earlier.

Food consumed by an animal may be compared to the fuel supplied to the boiler of a steam-engine. It is burnt in the system, and during the process of slow combustion, in changing its form it supplies the energy necessary to keep up the heat of the body, and to support the various animal functions, including exercise or labour.

Food is usually divided into three classes:—(1), Albuminoids, which used to be looked upon as merely "flesh formers," but which are now thought to play a larger part and meet other demands in addition to that indicated; (2), Oils; and (3), Carbohydrates, such as sugar, gum, starch, and digestible fibre. To this latter group, as regards their functions, *Amides* should properly be added. Though it is widely known that food consists mainly of those substances, it is not so generally understood that the proportion which they bear to one another is a matter of the very greatest importance, because an improper balance impairs the natural power of digestion as well as prevents the digestive system of an animal making use of the ingredients actually present. In short, the assimilating system of an animal exercises what might be called a power of selection, and rejects, or allows to go to waste, all materials which are above a due proportion, however digestible in a normal state. Roughly speaking, and without going into decimals, it has been found that the food of animals which are encouraged to take sufficient exercise should have five times as much of albuminoids as of oil, and that the carbohydrates should be nearly five times the weight of the albuminoids. It is usual to multiply the amount per cent. of oil in a food-stuff by 2·5 to bring it to its equivalent in starch. Then the "albuminoid ratio," or the "nutritive ratio," is fixed by finding how many times the percentage of albumen will go into the percentage of starch and oil, brought as explained to a supposed level. It may also be broadly stated that this albuminoid ratio suitable for an active animal is approximately 1 to 5.

Enough of importance is not usually attached, especially in a hot country, to what appears to me to be an absolute necessity, viz., a due proportion of oil. The great importance of oil during the process of digestion is very frequently unnoticed. Oil brings about a mechanical condition favourable to the assimilation of the other ingredients of food associated with it.[1]

It is a well-known fact, that since cake-pressing appliances have become more perfect, more oil has been removed from such cakes as linseed and cotton-seed cakes, and the residue is then much more indigestible, apart altogether from the hardness, which can be overcome by grinding. The first function, therefore, of oil in the digestive system is an aid to the assimilation of the other materials which form food ; and up to a certain point, on the united pleas of health and economy, oil is indispensable alike in the tropics, the temperate, and the colder regions. This assertion is borne out by native practice in the feeding of both men and animals. Ghi is daily consumed by the people ; and in dealing with the horse it will transpire that in good native management a moderate quantity is added to the rations of grain. It is no uncommon practice in Britain to give horses that are very hard worked, such as in hauling or carting heavy timber, 1 or 2 oz. of linseed oil in their feed of oats. The animals get extremely fond of it.

Oil is largely supplied to cattle in the unpressed seeds of cotton in the cotton districts. It is also present in very useful proportions in the solid residue from oil press mills of simple native construction. It is further supplied in the oil seeds that are present in the varieties of mixed foods of cattle in different parts. But it is not present in anything like sufficient proportion in the gram-fed cattle which I have drawn attention to. Its absence is all the more felt in the case of cattle which are not doing a full complement of work ; because work in itself, if not overdone, acts as a stimulant to digestion. Professor Church, in his *Food Grains of India*, shows that horse gram, *Dolichos biflorus*, L., contains 22·5 per cent. of albuminoids, 56 per cent. of starch, and 1·9 per cent. of oil. The latter is far short of the standard proportion—1 of oil to 5 of albuminoids ; and

[1] Michael Foster's *Physiology* says that "secretion of gastric juice is inhibited by the mechanical action of the substance on the gastric membrane."

further, the nutritive ratio is 1 to 2·7 in place of 1 to 5. Gram, consequently, however excellent, as it admittedly is, as an ingredient of a well-balanced food, is by itself far from perfect. It should be clearly understood that the excess of albuminoids in the ratio as stated is passed in the manure. There is a further loss in this case not only of albuminoids, but also of starch, on account of the deficiency of oil. To follow the loss still further, in passing through the alimentary canal waste products such as I have named might do serious injury if not largely diluted with bulky food-stuffs, such as grass, silage, or bhusa. I have not an analysis of bhusa, but I adopt the figures from an analysis of oat-straw, which, grown in this country, is in any case superior to the usual run of Indian fodder straw. I find the albuminoid ratio of the digestible parts of oat-straw is 1 to 30. It should now be amply apparent that bhusa and gram given alone to cattle is not only an inferior food, but one which entails much unnecessary waste.

THE GOVERNMENT CATTLE FARM AT HISSAR

Is situated on the line of railway running south from Lahore, and skirting the boundary line of the Punjab where it touches the north-eastern portion of Rajputana. The following facts relating to it were elicited from the energetic officer in charge:[1]—

The farm extends to about 63 square miles, and consists mostly of pasture in an open jungle; cultivation is said to be only possible to the extent of about 2000 acres.

Water is got from pools during wet seasons, and from wells 100 feet to 120 feet deep when the surface is dry. Some of the latter turn out brackish after working for a few years.

The grand total of cattle on the farm was a little under 7300, and of these there were 3000 cows, which were kept in herds of 40 in number, with two bulls for each herd. Of

[1] Captain Marrett had been manager of the farm for three years.

the yearly produce of four-year old bullocks about 400 to 500 were until last year annually transferred to Government service to supply the military department, after being "handled" for six months, and the remainder were sold as unfit for ordnance purposes.

The farm is credited with Rs. 100 for each of the bullocks delivered over to the army. Castration at Hissar is done by crushing when the bulls are 3½ years old, and consequently there is no defect in the development of masculine characters, as noticed when early castration is adopted.

On account of horses being considered more valuable for certain branches of the service, these are now made to do the work in place of bullocks, and in future only about 300 of the latter will be yearly wanted.

Besides cattle there were 2400 sheep kept.

The annual expenses of working the farm come to Rs. 42,000. **The rent** nominally assessed by Government is Rs. 13,000.

The Breeding Stock.—The farm is supposed to produce pure bred cattle belonging to the *Nagore*, *Nellore*, *Gujarât*, and *Sind* breeds, but as the management in years gone by has been very far from satisfactory, many of the cattle representing the breeds named are a very mixed and mongrel lot, accounting, so far at least, for the unsatisfactory returns at the end of the season. In addition to these, there were herds of cross cattle bred from the four larger and stronger breeds by Mysore bulls, and in this branch in particular a decided improvement had taken place within the last few years. Though admitting that good animals can be produced from cross cows by the use of good bulls from one or other of the original parent breeds that called the crosses into existence, yet when these are far removed from their natural conditions of soil and climate, the best results need not be looked for, as even the pure breeds, which do not possess the impetus given by crossing to reversion or change in the direction of inferior qualities, tend to fall away from some of their natural and often valuable characteristics on account of the change in the surroundings. This, and also the further fact, that it is unsatisfactory to "dash" a pure breed with a cross bull, however much superior he may look, seems to be fully understood by the natives, if one may judge from the unsatisfactory demand, even at moderate prices, for the cross Mysore bulls offered at the Hissar Farm. For these reasons it is absurd to talk of *improving* all or many breeds of Indian cattle in all or many districts by crossing with Mysore bulls, because the result would only be mongrels, unless, by means of pure bred bulls, good blood was constantly poured into each district until many generations had passed, and until the imported breed had practically asserted itself. Suppose for the sake of argument that this had been accomplished, which would be a very hopeless task indeed under prevailing practices in rearing country cattle, the animals resulting would have been materially changed by the influence of local surroundings differing from those under which the Mysore breed had attained their superiority. The likelihood is that the Mysore breed would remain, but considerably shorn of the valuable qualities for which it is now appreciated.

The most rational, and by far the safest and least expensive plan of improving cattle, is to select the best of the good breeds existing in the separate districts, and while improving these elevate the average of the poorer cattle, by judicious distribution among them of bulls of the best blood of their own varieties. By this method not only the tendency to degeneracy ultimately resulting from cross breeding would be removed, but the difficulties attaching to climate and soil having been already adjusted, there would be a clear course to improvement by judicious selection and better management.

One advantage may be gained by having a large central breeding station like Hissar, where a number of pure breeds from various districts are collected for breeding purposes, if the place is worked in connexion with smaller breeding centres of local cattle in those districts—that is, if the bulls used were imported from their home quarters. It has been found in the case of cattle, say shorthorns, taken to America from England, that their young, bred in America and then returned to this country, had, meanwhile, gained in constitutional qualities by the temporary change of circumstances. There is little doubt but that the rule would also hold good among Indian cattle.

Shoeing is necessary for cattle that are much used on hard, metalled roads. Bullocks which work on the land do not, as a rule, require it. The shoes resemble much the toe-plates nailed to the soles of the boots of workmen in country districts in Scotland, only they are a little larger and proportionally more substantial. One is fastened to each digit by nails of an ordinary "smithy" shape. In Ceylon, where at times thin weak shoes are employed, their lasting power is increased by the use of round nails with large rounded heads, like great rivets.

The method of throwing and securing the animal is the same as that adopted while preparing for the operation of castration. A cotton rope is selected because it is soft and easily manipulated, and does not chafe or injure the skin. A running noose is thrown over the horns, and the rope is then half hitched round the middle on the "near" side, in the region of the heart, and again round the belly at the flank. The loose end, after being passed round the "far" hind leg in the hollow behind the pastern, is pulled from the "near" side, and the animal is easily rolled over in the other direction and secured, so that he can do little damage by kicking, which, moreover, after a few ineffectual trials he does not attempt.

Animals with defective formation of the hind limbs, as, for example, when too straight in the hocks, do not flex their legs sufficiently or lift their feet properly in walking, and are apt to drag off their shoes by scrubbing the toes on the road.

CHAPTER VII.—MILK.

Milking—Distribution of Milk—Disposal of the Calf—Milk as Food—Buffalo Milk—Goat's Milk—Disease resulting from Want of Milk—Yield of Milk and Butter—Colour and Quality of Buffalo Milk and Butter—Products of Milk—Butter used Fresh and as Ghi—Buttermilk—Curd in various Forms—Clotted Cream.

MILKING is performed by the men of those castes which by privilege have secured to them by the unwritten laws of common consent what practically amounts to a monopoly of dairy employment. Very frequently the cattle are used as substitutes for milk distributers as well as in their natural function as milk producers. They are driven from door to door, and the milk drawn in the presence of the customers. This serves a double purpose: it shows that the milk is not adulterated, and it satisfies the religious scruples of those who might have been defiled through the milk being handled by some improper person. Those who come in for the first milkings pay the penalty of getting the poorer quality of milk, which is naturally yielded first by all cows.

When the practice of driving the cow round is impracticable, as in large centres, such as Cawnpur, milk is conveyed by men in open-mouthed vessels suspended from a springy pole laid over one shoulder. To keep down agitation of the milk on the surface and to exclude the sun, twigs are stuck in the mouths of the vessel—*gugras*. This practice is truly scientific and infinitely superior to closing the opening completely. It allows of the escape of the cow aroma, which in the hot climate would, along with other exciting causes, rapidly produce acidity. A whole chili or a mango twig is supposed by the natives to have a powerful influence in retarding acid fermentation.

The native habit of squatting on the heels—or in Scotch, sitting on their "hunkers"—does away with the necessity of using a stool in milking. See Plate XVI. (*b*).

Before the man begins, the **calf**, which is usually reared or kept alive in a state of semi-starvation on a very small proportion of the moderate yield of its mother, is first allowed perhaps one-sixth portion ; it is then tied to the foreleg of the cow, and no doubt with its struggling to get free, in obedience to the strong instinct to suck which has merely been excited without being fully gratified, it encourages the natural flow of milk from the udder, by inducing in the mother that tranquillity and that sense of satisfaction which is common to all the animal kingdom when in the sole possession and full enjoyment of family relationship of an agreeable kind. It is generally believed that a typical Indian cow will not give milk unless her calf is present, or a **dummy calf** is substituted. This is more or less a fact, but results entirely from the system of management and training. The circumstances are similar in the case of British cows if kept in the semi-natural state in which Indian cattle are reared in villages. If the calf were removed without permitting the cow to smell or lick it, as she naturally does, and if it were hand-fed from the pail, the milk would in a few days after parturition flow as freely to the action of the milker's hand as from an English cow. It might in some cases take two or three generations to pervert to the full extent the instinct governing this matter. The rule is not without its exceptions, as **Plate XVI.** (*b*) represents a cow being milked after the death of her calf without any attempt to deceive her. Her attention was occupied, according to a very general practice, by some food given at the beginning of the operation, and her hind legs were tied to prevent kicking.

Milk enters largely into the diet of well-to-do-natives in

India, both in the normal liquid form and also in numerous artificial forms. It constitutes a very important part of the food of Hindus who do not eat flesh, as through it they derive substantial nourishment, which greatly raises the standard of their bill of fare. **Cow milk** is that commonly used as a liquid. In some parts, as at Madura, it is the custom to drink milk only in the evening, though this is by no means general. **Buffalo milk,** although drunk in some places where the buffaloes are well fed and yield rich produce, is more generally subjected to some process of manufacture before it is consumed. **Goat's milk,** again, although an article of general consumption, is especially used for invalids, as is the custom in this country. Buffalo milk is less digestible than cow milk, but as regards degrees of richness this varies with the breeds and with the food supplied. In Western India, where buffaloes are large, they are often better fed than the cows, and then they yield milk of good quality; but in Madras and Southern India, including Ceylon, the breed is often neglected, and the yield is poor in both quantity and quality. The natives say if they drink this poor milk regularly they are liable to suffer from rheumatism; and attacks of dysentery are at times attributed to it.

No doubt one fruitful source of diseases of the skin prevalent in districts where the poorer classes exist largely on Ragí, *Eleusine coracana*, is the absence or insufficient supply of milk.

Yield.—Where good buffaloes are well cared for, as in Bombay, Poona, or Gujarát, where they are fed on the best fodder and boiled corn, one will yield about 20 lb., or nearly two gallons of rich milk at a milking, which takes place twice a day.[1] The yield of butter from this quantity of milk is about 1¼ lb. An indigenous cow under similar liberal treatment produces little over half the quantity of

[1] M. Hossain says that in Northern India it is quite common for the Hissar or Heryana buffalo to yield 50 lb. of milk per day.

milk. With good, but at the same time ordinary food and management, two gallons from a buffalo and one gallon from a cow per day is more nearly the average.

Buffalo milk and butter are pure white in colour when the animals producing the milk are kept on artificial food. The butter assumes a greenish hue after the new grass comes with the first burst of rains. When the animal system has got accustomed to the change of food, the butter becomes more yellow in tint, but never so deep in colour as cow butter.

The aroma and the flavour of buffalo milk differ from those of cow milk. The taste may be described as insipid and fleshy—more like the taste of the milk of a mare—induced in a great measure by the consciousness that there is a want of *salt* in it. This saltless (wersh) sensation extends to buffalo butter also.

The products manufactured from milk are numerous, and vary much in character. At Cawnpur I noticed quantities of milk being carried into market, and made special inquiries as to its uses. The most of it is bought by confectioners, who usually give the money in advance, and secure it at 20 sers per rupee; cash prices being 17 to 18 sers per rupee. As retailed, it is sold at 16 sers per rupee, and in summer up to 12 sers per rupee. A comparison of these figures is interesting, as showing a marvellous difference in the profits of the middlemen in this trade as compared with a corresponding trade in the United Kingdom.

Butter, made up in small rolls, is supposed to sell for 1 anna per 2 oz. The price does not alter nominally, but in seasons of scarcity the sizes of the balls shrink perceptibly.

Buttermilk, or the by-product of butter, is greatly appreciated as a beverage, and is, besides, a valuable food. The slightly acid taste adds to its power of slaking thirst, as is known to most country people at home.

Butter is soft, and very soon becomes rancid in the heat of India unless kept in ice. It is made daily for European residents by the native servants shaking up the cream in a large bottle. To improve its keeping qualities, by destroying the germs which promote decay, butter is, by native custom, boiled or clarified, and then it assumes the name of **Ghi** or **Ghee,** which sells in the above market at from $1\frac{1}{4}$ to $1\frac{1}{2}$ sers per rupee. Ghi is very largely used in native cookery.

Curd, *dahi*, is one of the most important products of milk, if it does not occupy the first place. The Hindus make from it a great variety of dishes. It is kept three or four days, and the dishes vary, at the time it is finally prepared for eating, according to the degree of acidity which the curd has contracted by keeping.

When milk is dried into cakes it is named *khoa*, and forms the essential part of many native sweetmeats, which are largely consumed, having the properties of wholesome and nourishing food combined with those of ordinary confections. The drying process is at times stopped short, and *khoa* in a semi-liquid or viscid state is obtained, and called *rabri*. **Clotted cream,** *malai*, is also manufactured from milk.

The castes who are milkmen or buttermen and also herdsmen are Ahirs or Gowallas and Ghosies (Mohammedans). Other castes seldom sell milk, though they are not restricted from disposing of Ghi wholesale.

CHAPTER VIII.—CATTLE DISEASES.[1]

Important Diseases—Foot-and-Mouth—Anthrax—Rinderpest—Cattle Disease Prevention Act—Government Interference, Suitable and Unsuitable—Inoculation—Fencing—Breeding Centres Increased—Poisoning of Cattle, Intentionally and Accidentally.

THE diseases familiar to us in this country which are of greatest importance in India, on account of their being widespread or deadly, are foot-and-mouth, anthrax, and rinderpest. Pleuro-pneumonia, which has been playing such havoc in Scotch and English herds or dairies, is very local in its action in India, and when it does appear, which is usually in regions to the North-West, where it is known as *Pheepree*, it does not assume the same virulence of type.

Diseases in India are altogether more mild than their British correlatives, and less disastrous in their consequences, considering the prevalence of them and the great numbers of animals annually affected. It is asserted that the diseases under discussion are less contagious than the corresponding European forms. It is very probable that in reality disease itself is every whit as catching as our home diseases if tested under similar conditions, and that the difference lies in the different constitutions of the animals brought in contact with it. Disease may almost be said to be universal in some districts; at least, it flows,

[1] For details and numerous local names, see *Manual of the more Deadly Forms of Cattle Diseases*, published by Government in Calcutta, 1885, from which I borrow the most important native names.

as it were, over the country from certain points in succeeding waves, and one wave has often hardly expended itself before another follows. In this way the action of the law of the survival of the fittest must have built up a race of cattle with qualities more capable of resisting disease than those not subjected to the chances of contagion, except at rare intervals, as is the case with British cattle.

The fact that English cattle in India are almost invariably cut off if disease approaches them, while only a percentage of the native cattle succumb to its influences, goes some considerable way towards substantiating my theory. If adopted, it serves at the same time to explain why proportionately fewer cattle die of disease in India than in Europe. The hot weather materially checks the progress of disease, yet it always lurks in places till a favourable season for its propagation comes round.

Foot-and-Mouth Disease—*Khurpucca* or *Khur* in Bombay and North-Western India, *Aishu* in Bengal, and *Mupaung* in Madras—may be said to be milk-mild, and wants no interference whatever on the part of the Government authorities, and very little extra care on the part of the owners. Given food easy of consumption and the necessary shelter from climatic influences—sun and rain—in a little time an animal will usually recover from the disease, which leaves no dregs or consequences behind. At times, if the attack comes during the wet season, the hoofs may slough as Nature gradually prepares new ones to take their places; but in any case, unless when by carelessness maggots are allowed to burrow between the horny casing and the digit proper, and bring about alterations of structure, the foot ultimately becomes as strong and serviceable as before.

Anthrax, also called Gloss-Anthrax, Black Quarter, and Splenic Apoplexy.—"*Goli* and *Suth* (Punjabi), *Golafula* (Bengali), *Gutherewan* (N.-W. Provinces), *Odro* (Bombay), and *Thaloreenova* (Madras)." This is a blood germdisease about which there are great varieties of opinion in India, and much remaining yet to be learned. What little is known about it is mostly connected with its ravages among horses. Although belonging to the same class of diseases as British anthrax, or, possibly, the anthrax met with at Cape Colony, yet there seem to be considerable minor differences in each case. That ignorance should prevail on this point is not to be wondered at, when we find authorities at home confounding anthrax with *braxy* in sheep, which varies from it in one very important and marked particular, namely, that braxy inoculation does not poison the system of man or other animals, while the blood of an animal suffering from anthrax acts as a malignant poison.[1] When all these varying forms of the disease are thoroughly investigated, it will most probably be found that the germs associated with them are the products of divergences from one parent stock, induced by differences of climate and of constitutional disturbances due to varying circumstances in the animal's surroundings, and also to differences in the food supplied. Young cattle that are thriving rapidly are most liable to be attacked, and recovery is so rare, owing to the rapidity of the disease and the slow nature of ordinary remedies, that it would be excusable to doubt whether the cases of recorded recovery were really anthrax at all, or only some other disease mistaken for it.

Prevention is much better than cure in this case, and the prophylactic which has proved of the greatest service in Britain is a seton put through the dewlap at a few months old, and a change to poorer pasture on the first appearance of disease in a lot of cattle. The flesh is poisonous if eaten,

[1] In the *Veterinary Journal*, January 1888, a paper by Nunn, of the Army Veterinary Department, shows that the South African *horse sickness*, which he divides into four forms of one disease, and which has been mistaken for anthrax, is not anthrax, but a malarial disease, mostly confined to horses and mules, and that no serious consequences attend the inoculation of other animals with blood or mucus from those that are diseased.

and smells strongly immediately after death, owing to an unusually rapid process of decay.

Rinderpest.—"*Bossonto* (Bengali), *Gootee*, *Checchuck* (N.-W. Provinces), *Pitchinow* (Bombay), *Peya* (Madras), also *Matah*, or a kind of smallpox owing to eruptions appearing on the skin." I came across it under the name of smallpox at Nariad, and there, as in most parts of India, it had done its work without the fact becoming known any distance beyond the family circle of the large zamindar who owned the cattle.

Rinderpest is distinctly typhoid in its nature, and is accompanied with lesions in the true stomach and intestines. In Europe, where it appears in its most virulent form, it is the most deadly of all known cattle diseases, and is attended with great suffering to the animal. As the disease is a prolonged one when it runs its full course, careful nursing in the matter of treatment is more than half the cure. Though rinderpest carries off good cattle, it plays greater havoc among the poorer and weaker specimens, and thereby gives a sort of show of reasonableness to the very erroneous argument, that disease is a benefit by undoing overcrowding. Where a district is overstocked a more rational method than this is surely available.

The amount of injury and loss resulting annually from the unchecked ravages of disease in India is something enormous. From the Scotch point of view, that "saving is gain," the matter is of such importance,—an importance which is increasing every day with the increased pressure of population looking to the land for their support,—that it would warrant Government in establishing a department, though its duties were only the stoppage of disease. It has been asserted that if we were to interfere with the ryot in the management of his cattle we should have another mutiny. After making numerous inquiries regarding this matter of educated and leading natives in all parts of the country, I have satisfied myself that anything of the sort is as absurd as it is impossible, and that few would even grumble if the regulations passed by Government were on enlightened lines, which would ultimately prove to be of benefit to the country. There never was a theory so absurd that it could not find some supporters, and I believe that there are officials in India, of many years' service, who have been so much confined to their offices and to the work of their desks, that they know little of native country life, and honestly think it would be dangerous to try anything in the way of improvement.

A Cattle Disease Prevention Act was passed in Madras in 1866; and although it is unnecessarily strict and severe in some particulars, it has not produced the social discord prophesied by some.

The Madras Act begins where the regulations I would suggest might end. It would no doubt give excellent results if it were possible to carry it out; but it appears to me to go too minutely into detail for the present state of advancement of knowledge, and to minimize the one main point which alone could make its operation of real value.

Direct Government interference is only necessary, or will only prove efficacious in large questions of policy, such as—(1.) Placing under quarantine areas in which disease has broken out; and (2.) The suspension of bullock traffic on certain highways where it is known that such traffic would lead to the spreading of disease to healthy parts. What appears to me to be the first function of Government is to protect the great mass of the people from an influence which they themselves, however willing to do so, are yet powerless to avoid. It becomes, further, a very responsible duty on the part of Government in a question of such magnitude, and it is one which no amount of local inconvenience in disease-stricken districts should induce them to neglect. Having taken means to prevent the extension of the disease to wider areas, Government might then trust to local effort to suppress it, or reduce its consequences to a minimum. If Government disseminated a knowledge of the means of suppressing diseases among the village officials and leading natives generally, and strengthened their hands by an Act which they could adopt when occasion called for it, much better results would unquestionably follow. To attempt to coerce the native by British legislation in matters of detail connected with cattle must, owing to the nature of things, defeat its own ends. The native does not comprehend the object, and he has no experience of the value of the results. He has means, which we cannot cope with, of concealing diseased cattle. I feel very strongly that we can only appeal to the native in such a matter through the argument of self-interest, and it must be by imparting to him the knowledge which we ourselves possess, and this, I hold, it is our bounden duty to do. The other matter, that of quarantine, or restriction of egress and ingress, is on an entirely different footing. It is an imperial, not a local measure,—one respecting the interests of the community, not of the individual. It is freed from all local influence, and is capable of being enforced.

As a guarantee to a village or community against disease from without, it would act as the strongest possible inducement to get rid of disease within. The constant liability to fresh and repeated invasions of disease from distant quarters, quite away from the influence of any one centre, seems to be a sufficient reason for the absence of all efforts to suppress disease.

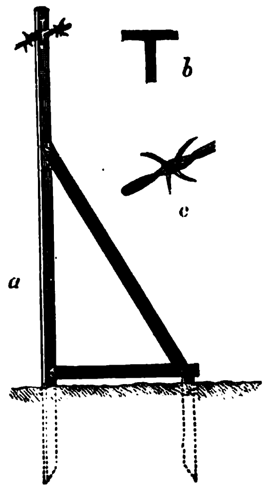
A man or a community will make a special effort, or even a sacrifice, to attain an end which is to be more or less permanent; but it is contrary to human nature to continue to struggle in a cause which all experience, and even tradition, pronounces to be hopeless.

Natural circumstances greatly add to the possibility of exterminating disease in India as compared with this country. The hot weather gives it a decided check, and this only requires for its almost complete success the aid of suitable means; and in due time, when the benefits are generally recognised, the hearty co-operation of the people.

I have been told that disease is transported by kites and vultures, and also brought to certain districts by rivers; and that, in consequence, restrictions on the movements of cattle would be futile. With the likelihood of the former suggestion I do not concur, although I admit its possibility in such a disease as anthrax, and I am supported in my unbelief by high veterinary authority. As to the latter I may say, if disease were not put into a river it could not be communicated by that river. There is no such thing as *spontaneous generation* or *special creation* of the virus of a common contagious disease. The causes being known, the remedy is not far to seek.

Inoculation has been mooted as a general panacea for all Indian diseases. As such, it will prove most disappointing; but as a special treatment, it might be useful under certain circumstances. With such as Government cattle, which can be nursed during the fever resulting from the operation, and the tails cut off when necessary at the proper time, it might prove perfectly successful. My objection applies not to inoculation itself, but refers to the great difficulties which stand in the way of its introduction on a large scale, especially when two or three separate and distinct diseases have to be guarded against.

The farms where Government cattle are reared and grazed are not fenced, but are free at all points to admit among the healthy animals the suffering wanderers from the surrounding hotbeds of disease. I do not know who is to blame, and I simply record the fact as leading up to a grievous loss of public property. I was told of repeated outbreaks of the most deadly forms of disease, directly traceable to cattle finding their way on to the Government lands, when these might have been easily kept back, and the serious consequences averted, by a most inexpensive fence. A diseased wanderer is not difficult to divert from his path: even healthy cattle are securely fenced by a single barbed wire, placed on T-steel standards (see Fig.) about 3 feet high,[1] if they are not "hounded" against it. Cattle do not attempt to jump over a single wire, and only very few learn to crawl under it. The hump would practically prevent this, as it is only animals with unusually low shoulders that succeed in passing under a properly erected wire at home.



a. Standard in position in the fence.
b. Cross section of the steel bar forming the upright.
c. Section of the twisted steel wire, showing barb fastenings.

Any of the common species of aloe[2] used for fencing in India, if associated with a "single-wire" fence, would make a most effectual barrier against smaller animals as well as against cattle.

The Hissar Farm, with an area of 63 square miles, where over 7000 head of cattle are kept, could be sufficiently fenced by a capital expenditure of £600; yet rather than incur this outlay, the boundaries are left unguarded. Each serious out-

[1] Mr A. Thompson, Dumfries, estimates the cost per mile of the material for a suitable fence at £10. "The standards to be T-steel, 1" × 1" × ¼" (stays 1" × ¼", flat), placed 12 yards apart, and one galvanized steel, four-point, barbed wire 3 feet above ground, straining pillars 1⅜" square, with self-fixing bases and earth plates, and winding brackets placed 500 yards apart." The weight would be 18 cwts., and the cost of erection in this country £2, 10s. both per mile. Carriage to India and additional cost of erection would be covered by an additional sum of 50 per cent. added to the home price.

[2] The two most common fencing aloes—but also valuable for the fibre they yield—are (1.) The American Aloe, *Agave americana*, Linn. It is most widely distributed. It has a strong growth, and is of a bluish-green colour. (2.) Adam's Needle, *Yucca gloriosa*, Linn. The latter I found most abundant in Madras. Its habit of growth tending to form a bare stem necessitates its being periodically earthed up when grown as an ordinary fence. This property adapts it admirably for a loose or unstable bank or railway cutting. It binds

break of disease is productive of greater loss than the total cost of a permanent fence.

The Amrit Mahal grazing grounds, I admit, could not be totally fenced—they are so broken up; but a few miles of wire fence erected at certain places where village cattle naturally trespass would be a great means of safety.

Through the Sidapet Farm lies an unfenced public highway to a slaughter-house—the place of all others where diseased cattle are likely to be sent if not turned adrift, and repeated attacks of disease have resulted from its presence. No such handing over of public property to the tender mercies of fate could possibly take place in this country, where the breath of public opinion blows freely.

Breeding centres ought to be increased, where conditions, as of land and climate, are suitable, to reduce the risk of disease. Centralization in this matter has been in favour, but can easily be carried too far. It has been already pointed out that, as a rule, cattle bred for generations in a district acquire qualities peculiarly suitable to that district. Private enterprise should consequently be encouraged, or at least be permitted to develop breeding establishments, where land is available, under sufficient guarantees as to its being used for the purpose intended.

Poisoning of cattle is practised by the *Cobbler* caste, which, according to custom, has a right to the skins of all cattle that die in a village. It is usually accomplished by throwing the leaves of some species of *Datura* or a plantain leaf spread with arsenic to a cow which is perhaps tethered out at pasture. The culprit then disappears, and waits until his victim has been conveyed to the usual place set apart in a village where all dead animals are taken; then he arrives and secures the skin. Of the native customs which will vanish as knowledge increases, this

the earth, and is yet able to keep its head above ground though particles of soil roll down on to its roots. A light green species much resembles No. 1, but it is not so often met with, and is not so suitable in a fence owing to its softness.

one regarding the ownership of the skins of dead beasts, which is a direct encouragement to serious moral shortcomings, will be among the first to go. I am informed that in some districts, when an animal dies in a suspicious manner, the owner slashes the skin, so as to make it of little value, and he thereby discourages evil practices in the future.

I heard of one case of the poisoning of some English cattle that had been taken up to a farm in the Darjiling district for milking purposes. It was not known whether the poison had been given by some jealous native milkman, or if the cattle had been poisoned by some wild plant unknown to the imported cattle. Both causes were suspected. If a plant were the cause, is it not possible that this is another illustration of the fact mentioned by Darwin in the first chapter of the *Origin of Species*,[1] that some animals with black skins enjoy immunity from the effects of poison to which white skinned races succumb?

[1] "Colour and constitutional peculiarities go together. . . . White sheep and pigs are injured by certain plants, while dark-coloured individuals escape." Then follows the famous illustration of poisoning by "paint-root, *Lachnanthes*, which coloured the bones pink, and caused the hoofs of all but the black varieties (of pigs) to drop off."

CHAPTER IX.—BUFFALOES.

Habitat—Aquatic Habits—Effects of Heat and Disease—General Points—Colour of Skin and Hair—Intelligence—Affection—Jealousy—Varieties of Buffaloes—Jafarabadi or Wadhiali—Kundi—Madras—Ramnad—Cinhalese—Talabda of Gujarát—Palia—Common Long-Horned or Bombay—Nagpur—Jowari of S. Maratha Country—General Management—Shaving—Attention to Breeding—Males—Solid Excrement of the Horse Eaten as Food—Philosophical Explanation of the Practice—Corresponding Practices among Cattle and Horses.

THE **Buffalo,** *Bos bubalus*, shares with the ox the position in the tilling of land which is occupied by the horse in this country. Buffaloes are semi-aquatic; their natural habitat—where they yet exist in a wild state, and are shot as large game—is the swamps in Eastern and North-Eastern India.[1] *Bubalus arni* is the scientific name given to the wild buffalo.

During the hot season buffaloes may be seen rolling about in muddy holes, or half submerged, or entirely under water with the exception of their heads or noses. In Ceylon, I have seen them picketed out for days together in meadows flooded with about 2 feet of water. They

[1] Jerdon says: "The wild buffalo is found in the swampy Terai at the foot of the hills, from Bhutan to Oudh; also, in the plains of Lower Bengal, as far west as Tirhut, but increasing in numbers to the eastwards, on the Brahmaputra, and in the Bengal Sundarbans. It also occurs here and there through the eastern portion of the table-land of Central India, from Mednapur to Ranpur, and thence extending south nearly to the Godavery. South and west of this it does not, to my knowledge, occur in India, but a few are found in the north and north-east of Ceylon."

live and thrive on the strong marsh grasses which are there of rich quality.

This natural inclination for water adapts buffaloes particularly well to the regions of heavy rainfall and to rice districts, where much of the cultivation is carried on while the land is under water. Cattle, especially the larger and finer sorts of them, which in strength are nearly equal to buffaloes, are injured by frequent wetting; and buffaloes are consequently substituted.

Buffaloes cannot endure the heat of the sun so well as cattle, and have in consequence to be unyoked during the middle of the day when the sun is most powerful. If this is not done, they become fevered or "sick," as the English-speaking natives term it. They are altogether more delicate than cattle. While the diseases they suffer from are the same, they do not so readily yield to treatment. They are, however, not so susceptible as cattle are to some of the deadly forms of contagious disease, such as Rinderpest.

As already explained, buffalo cows are kept and highly prized in certain districts as milkers.

General Points.

Buffaloes are extremely ugly. The horns, which vary in size and form more than among humped cattle, leave the crown of the head in a downward or backward direction. They are more or less flattened and marked with rings, indicative of age, as the animal advances in years. The smooth and polished-looking **skin** is usually black. Frequently one or more of the legs are white, and there may be a white spot on the forehead or the tip of the tail. *Vijalis* is the name given in Khandesh to an animal with a white belly or a white eyeball, and there such a mark is considered unlucky.

In the southern Maratha country, where white eyes are more abundant and usually associated with a white spot of skin near them, the idea relating to bad luck is not entertained, but such animals are said not to see clearly.

Dingy-white specimens, probably true albinoes, now and then appear. They are not so hardy as those with the naturally black skin.

Buffaloes are **not so leggy** as cattle in India. The larger varieties, although they may not stand so high as large bullocks, are more substantial, and would weigh more.

They are remarkable for their **great girth** round the region of the heart and for their deep bodies and well-formed shoulders, nicely joined on to the forward ribs. **The withers** are sharp, and rise above the level of the back, giving more or less the appearance of a hump, which, however, is absent. The back also rises considerably above the general level, immediately behind the region of the kidneys.

The parts which are particularly defective, from a European point of view, are the hind-quarters. These are short and drooping and badly packed, and the thighs thin and poor. They are much **wider** than humped cattle behind, between the points of the pelvic bones. **The bones** of the limbs are strong and well formed.

The hair of full-grown buffaloes is long and wiry, but sparsely distributed, and affords little covering to the body. In the larger varieties it is usually black, except on the patches of white skin, where it is white. See Plates XXXIII. and XXXIV.

Calves—Plates X. and XXXIV. (*a*)—and young buffaloes have a good covering of hair of a light colour, resembling the hair of the inferior breeds of Madras and Ceylon.

Buffaloes are much **more intelligent** than ordinary cattle, and when roused and furious are consequently more **dangerous.** They are **most affectionate,** and are made great pets of by the herdboys, whom they will follow closely like a dog when strangers are present, uttering every now and then an anxious or excited grunt, and making much of the same ado as a cow makes over her newly-dropped offspring.

Jealousy.—On one occasion, at Dharwar, I saw jealousy exhibited by female buffaloes in a marked manner. One was being caressed and fondled by the boy in charge, when another pressed itself between them, and gently thrust its head under his arm. The buffaloes were evidently quite friendly with one another, as they did not attempt to use their horns, but both strove to attract and monopolize the whole attention of the boy. I was told that these buffaloes do not settle to feed on days when their ordinary attendant is not with the herd.

The Jafarabadi or Wadhiali buffalo is noted for its extraordinary development of frontal bone covered with hair, and its short, though strong and very broad, flat horns, leaving the head in a decidedly backward and downward direction, then curling rapidly upwards on themselves, so that the points are quite turned in, and are useless as weapons for attack. This seemed at first rather peculiar, when I was informed that the breed was a favourite one in olden times for the supply of buffalo bulls to fight in the bull-rings of native Rajas. On further inquiry I was informed that buffaloes fight by butting like rams, and that it is consequently more a matter of strength of skull, and weight of body behind it, when brought into action in the rush or charge, than of power to push and do execution by the sharpness of the horns, as in the case of ordinary cattle. This mode of fighting, which I did not witness, but had described to me by a good authority, I take to be the reason why all the buffaloes which I encountered have the horns so much inclined backwards —to be, in fact, out of the way.

Some of the long horns almost look, by their proximity to the body as they go backwards, as if they might, by resting on the shoulders, act as supports to the neck and head. I was told further that some Rajas had bred Jafarabadi buffaloes so much for development of frontal bone that, in many cases, it had so enormously and abnormally increased that it actually covered the eyes, rendering the animals quite blind. This is a remarkable illustration of what may be done by man in the development of parts or qualities in their animals by artificial selections.

Plate XXXIII. (*a*) is an excellent representation of a buffalo cow of this breed, measuring over 60 inches to the top of the shoulders. The great, massive, and at the same time neatly-formed shoulders, joined on to a trunk to match, seem to be as near perfection as could be attained for an animal in moderate milking condition. The bridge of the nose looks more prominent than natural, as the animal, when photographed, was suffering from a large boil. The horns of the male are much broader, especially at the base, than those of the female. On the male they are at times quite 8 inches broad. The peculiar formation of the head separates the Jafarabadi buffalo from all the numerous breeds represented in the country. It is, perhaps, the best milking breed in India, when kept in suitable conditions. Cows are sold in Bombay at Rs. 10 per ser of milk given. I saw one which was said to give 24 sers daily. They are extremely mild-mannered in their bearing towards people—the result, no doubt, of long domestication.

Kundi or **Khundi** is the name given to the local breed of Heryana or Hissar, specimens of which may be seen kept for milking purposes in the neighbourhood of Cawnpur. This is not one of the largest sized breeds. Its most striking peculiarity is the short, thick, and much curled horns, which in form are not unlike those described above.

The Madras Buffalo is a small and inferior variety, which

Plate 33.

(b) X 8.

(c) X 10.

(b) & (c) BUFFALO PARASITES

(a) JAFARABADI OR WADHIALI BUFFALO.

Plate 34.

(a) RAMNAD BUFFALO COW AND CALF.

(b) GUJARAT TALABDA BUFFALO COW.

lacks substance. No doubt they have been made what they are by the dry and, for buffalo life, unfavourable climate. Some of them assume the size and appearance of regular dwarfs. I have seen a number little over 30 inches high when full grown.

They are black skinned, but differ from most buffaloes in having light grey in place of black or dark hair.

The horns are about medium length. The females are timed to calve in November and December, which is a little before the usual period for the majority of cows to produce their young. In spite of the fact that they are bad milkers, it is more profitable, under the circumstances, to keep this variety than the large Bombay buffaloes.

The Ramnad Buffalo cow (with calf), shown in Plate XXXIV. (*a*), belongs to the Madras breed, but is a very excellent variety, which is found in a district lying to the south-east of Madura. By looking in detail at the points of this animal, one sees a typical example of the best of her kind. She is thick, low set, strong boned, and large footed—or she may be more fully described as round in barrel, deep in body, and altogether symmetrical, with the exception of the common Eastern irregularity and weakness of the hind-quarters. She measured 3 ft. 9 in. in height to the top of the shoulder. The eyes are very large and dark. The hair is light, the usual colour of the Madras buffalo. Very peculiar looking, long, curling, moustache-like hairs, swirl round from the knees. These are usually well developed in good specimens. Although, perhaps, unusually prominent in this breed, I noticed them in most of the other breeds. A long fringe of white hair skirts the edges of the upper side of the ear to about half its length from the base towards the point. A good development of this is indicative of good milking qualities. The hair on the legs, lower lip, and part of the upper lip is of a "mealy" hue—the latter gives the appearance of a slight moustache. There is also a peculiar fringe of hair on the lips of the vulva. White spots on the body are rare. The udder and teats are well formed and of a flesh colour; this is usual, but not invariable, some udders being black like the skin. The milk given is about double the quantity yielded by a good local cow, amounting to 10 lbs. twice daily, besides the calf's allowance. The hairs on the back of the udder are reversed, so as to form a large and distinct escutcheon, but on several other good milkers of the breed this particular marking is almost absent. The horns are of medium length—flat and curving in at the points. Owing to their backward direction, they come in contact with the top of the shoulder as the animal turns her head. Frequently the horns turn inwards so much that the points cross each other, and a complete circle is formed. The rings on the horns indicative of age are also distinctly seen.

The calf was 1½ years old, and possessed the peculiarity, unusual in most breeds, but particularly so in this, of white skin on its breast and under its belly.

Cinhalese Buffaloes are more like the small and inferior Madras breed than any other. They are leggier, stand higher, appear to have larger and more pendent ears, and they are even worse milkers.

The Talabda or indigenous breed of Gujarát, in the neighbourhood of Nariad, is much smaller than the Jafarabadi, and gives less milk, but in proportion to the size perhaps quite as much, and from it more butter can be got. Though smaller than the large variety of Jafarabadi, this animal is of a good size, has a heavy barrel, and is well put together. The horns vary somewhat in length. They are not nearly so long as those of the Common Bombay buffalo. They may be said to vary from short to medium lengths.

Plate XXXIV. (*b*) shows a very good representative specimen in calf, and almost at the "dropping."

The Palia variety in the Nariad district is the small,

Plate 35.

DECCANI AND NAGPUR BUFFALOES WORKING A WELL.

Plate 36.

(a) DECCANI BUFFALO BULL.

(b) DECCANI BUFFALO COW.

poor man's buffalo. It resembles the *Talabda*, but it is more hardy, and can live on starvation rations.

The Common Long-Horned or Bombay Buffalo is a massive, low-set animal with black skin and black hair, and possessing long and sweeping horns descending downwards and backwards, but at the same time very irregular in their inclination. This breed is noted for its milking qualities, and is largely kept in Poona and the west of the Bombay Presidency for the purpose of milk production.

The Nagpur Buffaloes which I saw in and around Dharwar could be described in exactly the same terms used in the case of the Bombay buffalo ; they might easily pass for one and the same breed, if in reality they are not identical. The horns, as shown in the long-horned specimen, Plate XXXV., curve up as the point is approached. These buffaloes belong to the *Gowli*, or milkman caste, and some are regularly imported every year—although the trade has fallen off within the last twelve years, as breeders now find sale for them at centres nearer home. The cows of this breed can better endure knocking about while milking than the shorter horned Gujarát buffaloes, which are also imported into the Southern Maratha country. Male buffaloes of the Nagpur breed grow to a large size, and are sold to wealthy natives, who usually keep one pair at least for very heavy draughts.

The Jowari, or local breed of the Southern Maratha country, as about Dharwar, has moderately long horns, which go backwards, curving up, so as to form almost a half circle, *vide* the short-horned specimen in Plate XXXV.

Though black is the prevailing colour of skin, in some cases it is brown or chestnut, and the hair is usually of a dun or dirty-whitish colour. The shanks, tip of tail, eyes, and patches on the head are often white.

The breed is smaller in size than the imported cattle. Surplus males are taken down into the low country below the Ghats to work in the rice lands, where the climate is such that neither buffaloes nor bullocks last so long as when working above the Ghats.

General Management.

In Western India the hair is **shaved** off (generally in November and December) to destroy the harbour of the buffalo skin parasites, represented in Plate XXXIII. (*b* & *c*).[1] The knife used for the purpose is about 12 inches long, and is sometimes made from a worn-out smithy file. **In the East** (Madras) shaving is not practised, but the same purpose is served by rubbing off the hair in washing.

More attention is paid in some places to the **breeding** of buffaloes from good sires than in the case of humped cattle. Natives say this is more easy, as buffaloes are more tractable.

The rule holds good in the case of buffaloes as with cattle, **that varieties which are peculiar** to certain districts, if bred in other parts under other conditions, do not succeed so well as at home. The descendants break away from the qualities for which the parents were famous, and become more or less degenerate. It is found that the buffaloes belonging to the Nagpur breed, when born and reared in the neighbourhood of Dharwar, neither look so well nor milk so well as imported specimens.

Male buffaloes are castrated at the same age as young bulls; they are also generally broken to work at four years old. In Ceylon, where buffaloes milk but poorly, giving

[1] (*b*) was taken by means of microphotography from a transparent slide. The louse, *Hæmatopinus tuberculatus*, Piaget, or *H. buffali*, de Geer, represented was brought from India by Colonel Mason, and belongs to the Edinburgh University Museum. (*c*) was photographed from a drawing by F. G. Binnie, and represents a tick, one of the *Ixodidæ*, which the author picked from the ear of a milking buffalo in the Esplanade, Bombay. A. D. Michael, who has examined the drawing, says "it seems to be taken from a male of some species, closely resembling or identical with *Hyalomma marginatum*, Koch."

only two or three bottles daily, the females are made to work along with the males in the cultivation of rice land.

In Gujarát, where the object in keeping buffaloes is to get milk, the males are not required, and as it is against the religion to kill animals, the *he*-calves are starved to death.

Solid excrement forms a considerable part of the food of buffaloes, even when well cared for. The revolting part is the deliberate way in which the buffalo greedily consumes, as it is yet warm, the droppings of a horse. There is no real objection to the animal being allowed to follow its instincts, although they may be considered mean. The objections are purely sentimental. It is a well-known fact, that not nearly the whole of the nourishing ingredients of food are abstracted by any animal under ordinary circumstances in the process of digestion, more especially if it is highly fed; and again the nourishment taken into the system is not at all absorbed by the walls of the stomach, as one is too apt at first to suppose, but by the lacteals, etc., of the intestines throughout their length. It follows, then, that immediately before an animal voids its excrement, the bowels are abstracting a portion of nourishment from that excrement, although it may be admitted that the amount is not very great in the lower regions of the bowels. It remains yet to be proved that the nourishment taken up by the animal economy is less pure when abstracted at the lower end of the intestines than when taken from the food or *chyme*, soon after it enters them from the stomach. The consumption of dung by a buffalo is, from a scientific point of view, practically equivalent to the extension of the alimentary canal of an animal to twice the normal length. Certain ingredients in the food are actually more digestible when consumed the second time. Starch is liberated from its casing of indigestible fibre. And further, we learn from Foster's *Physiology*, that "the fæces contain a ferment similar to pepsin, and an amylolyctic ferment similar to that of saliva or pancreatic juice," and no doubt these substances act as aids in the process of further digestion.

The fæces from an animal in a normal state of health and under a normal system of feeding are free from putrid matter, or the products of unnatural fermentations, which sometimes result when the functions of the animal system are out of gearing. There is no nausea or other sign to indicate that they do not agree with the buffalo.

Cattle.—Those who feel repugnance at the buffalo eating dung are perhaps not aware that our own British cattle are extremely fond of litter soaked in horses' urine. It is a common practice to throw stable manure and wet litter into the cattle-yard to supply bedding. The cattle consume a quantity of it with avidity. I believe they do so because of the salt present in the urine. They keep within limits in this practice, and do not go to such an extent as some cases I have witnessed of Indian cattle, notably on my way down from Simla to the plains. It was quite common to see a bull or bullock go to a dung heap near a tonga station, and eat the bedding, refuse fodder, and horse dung together without any attempt at selection.

Pigs.—Further, many of the American pigs that supply our markets with ham and bacon live entirely on maize which has been given whole to cattle and passed by them in that condition; or they feed simply on the dung in cases where the corn is first ground into meal, so that it cannot be voided whole.

Plate 37.

(a) MANIPUR PONY.

(b) KATHIAWAR HORSE.

CHAPTER X.—HORSES.

The Horses of India—Manipur—Káthiáwár—Bhutia—Horse Breeding—"Walers"—Tonga Ponies—Their Food—Native Methods of Feeding—Pampering and Overfeeding—Injuries to the Horses and to the Community—Anthrax in Horses—Treatment—Cape Anthrax—Disadvantages of Neglecting to Castrate—Methods—Efforts to Improve Horse Breeding—Barrenness—The Officer in Charge—Breeding—Horses suitable for Breeding in India—The Yorkshire Hackney Stallion the Best—Ladybird—American Experiences—Importance of Position of Bones of Horses' Shoulders.

THE **horses of India** are largely Arabs, or the descendants of Arab crosses with aboriginal types. They are consequently, as might be inferred, small in size and light in bone and general substance. In a country where cattle are so much used, horses are not nearly so numerous as in countries where they occupy the first place as beasts of burden. I was particularly unfortunate in having unsuitable weather for photography when among the best representatives of the Indian breeds of horses. After all my efforts, I have only secured three pictures fit to be reproduced.

Plate XXXVII. (*a*) shows a **Manipur pony** of 11 hands, which was bought from the Raja of that district for Rs. 250. Though it has assumed an awkward position in the Plate, it in reality is a very superior pony, and typical of its breed, being extremely hardy and noted both for pace and endurance.

Plate XXXVII. (*b*) is of a **Káthiáwár horse** in very lean condition, and standing in an uneasy fashion on his forelegs. At the time he was recovering from a prolonged attack of founder (*laminitis*), induced by over-feeding. He had been getting, like the garry horses of wealthy zamindars in the district (Gujarát), a ball made up of the brains of a goat (extracted after the head had been boiled), a little ghi, and spices,[1] worked up with Bájra flour to give the ball consistency. This also is a good and characteristic specimen of the breed. The short prick ears, curving slightly in at the points, though typical, are not ornamental.

Plate XXXVIII. is of a **Bhutia pony** of 14 hands, worth about Rs. 300, being increased in value by Rs. 50 since the stoppage of Macaulay's Mission, the export of ponies from Bhutan being interrupted at the same time. This is a strong-boned, powerful, and very useful, hardy breed, largely employed by Europeans in the hill-tracts of North-Eastern India, as at Dárjíling.

Horse breeding on a large scale for army purposes has not been a success in India. This is to be regretted, although an abundant supply of most useful animals, suitable for all sorts of military requirements, is regularly drawn from New South Wales.

Government "Walers."—I made a careful and most interesting inspection of about 600 of these at Saharanpur. Taking them as average representatives of the class of horses (and they were reported to be in no way above it), I should say, from what I have seen and from what I have learned in other ways on good authority, that there is no army in the world so well horsed as the Indian army. When draughted for work they are classed into the different grades or qualities suitable for the various branches of the service.

One point which strikes an observer in looking through the heavier of these "Walers," is the valuable combination

[1] Spices generally given to well-fed cattle—(1.) Garlic, *Lasan*; (2.) Onion, *Diigli*; (3.) Green ginger, *Adoo*; (4.) Black pepper, *Muri*; (5.) Clove, *Laving*; (6.) Cinnamon, *Taj*; (7.) Zedong turmeric, *Amba Halder*.

(*a*) BHUTIA PONY

(*b*) YORKSHIRE HACKNEY MARE (LADYBIRD) No. 177.

of strength of bone and "breeding" in the one animal. It is an easy matter to get strong bone or to get "blood;" but what is most difficult to attain to, and what we really want, is the combination of the two. Walers, in common with all imported horses from cooler climates than that of India, have to be cautiously handled, and special care taken not to expose them unnecessarily to the sun for about two years, or till they become acclimatized. They land in India at about four years old, and the best sorts cost Government £50. Others range at lower prices, according to quality. While remaining in the recruiting quarters, as at Allahabad, until drafted for service, they are allowed per day, except during the very hot weather, well-nigh 20 lbs. of concentrated food, consisting of a mixture of gram, barley, bran, and chaffed unthreshed oats. They stand during the day in large airy stables, kept beautifully sweet and clean, the floors being regularly washed over with clay. At night they are let loose in a park. They are ridden in turn once a week by native riders. Although these men have but a loose seat on a saddle and little power to grip with their knees, yet with their "light hand" and gentle touch on the reins, they make excellent training grooms under a good European officer. The management seemed to be faultless. The horses were in a healthy and thriving condition, though thinner than they would have been in England with similar treatment.

Tonga Ponies.—One could not conscientiously come to the same conclusion with regard to the feeding and treatment of the Tonga ponies seen on the journey of ninety-six miles from Ambala up to Simla. I have seen cruelty perpetrated upon exhausted equine nature in more than one journey to a hill station that it is hardly possible to believe could have been passed in a civilized country without being visited by richly deserved punishment. These Tonga horses are large, well-bred, active ponies, mostly of Arab blood, and, as is usual with native horses, they are kept entire. To help to keep them cool the hair of the mane is closely cropped. In the dry weather they stand outside in rows, tethered in the native fashion by a rope round each hind pastern to prevent them kicking or encroaching upon their neighbours. No doubt the fact of their being entire makes this practice more necessary. There they eat from clay mangers built up to a convenient height.

The food in this particular case consisted of a daily allowance of 4 sers of soaked or boiled gram, given at night, 4 sers of dry gram in the morning, and 2 sers at midday,—in all 20 lbs., besides bhusa as bulky fodder. This is a most unscientific mixture, which in practice did not appear to work better than I should have expected. A mixture of other grains, including oats (although the latter are much more husky than in England), would have given far better results at no extra cost. No racing man would ever think of training his horses while feeding them on gram and poor fodder alone, because it is an imperfect if not an unhealthy food. It is too flatulent. A horse cannot gallop to do its owner credit, and a hack cannot work to the best of its ability, when passing fæces which smell like a cesspool.

The native methods of feeding, as practised by people of wealth with their ordinary working horses, is a much more rational system than this English adaptation. Though gram forms the greater part of the bulk of rich food, a moderate amount of ghi is added, besides other grains, and sometimes spices. The addition of ghi, although it seems at first unnatural to a stranger, is unquestionably an advantage in the Indian climate, if given in moderation, —say, 2 oz. at a time. No doubt the custom arose through natives feeling themselves benefited by its use, which is very general among all classes that can afford it.

The pampering and overfeeding of favourite animals in the stables of wealthy native princes cannot be too strongly condemned and reprobated, as cruel to the beasts themselves, and injurious to the best interests of the country. I spent some hours in one stable where over 100 of the finest horses—Arabs, Barbs, Marwars, and Káthiáwárs—that India could produce were tied up and actually fed as fat as pigs. Horses that had cost Rs. 18,000 and Rs. 20,000 were kept in close boxes with most imperfect ventilation, and were taken out only for show at rare intervals, and not at all for regular exercise. In addition to ordinary food, they got, mixed with it, 2 lbs. of sugar and from 1 to 2 lbs. of ghi daily. The first result of this feeding would be a rapidly thriving condition, accompanied with a sleek and glossy coat and an increase of fat; but the ultimate and most natural consequence proved to be the gradual breaking down of the system in each case at its weakest part through over-pressure. This accounted for the variety of diseases that appeared and developed and were running their course at the time referred to—*e.g.*, broken wind, founder (*laminitis*), weed (*lymphangitis*), skin eruptions or diseases, and fatty degeneration of the liver. All these, I noticed, were present, and no doubt there were others besides.

I was informed that a considerable number died annually of an unknown disease, and I was able to satisfy myself by examining what existed of it at the moment, and from the accounts of the two native veterinary attendants, that this unknown and fatal malady was fatty degeneration of the liver, which seemed to carry off most of those horses that escaped the other more rapid and better known forms of disease.

The injury to the community lies in this, that the best horses of the best breeds in the country are picked up—even those bred by Government stallions—and brought to these stables; and if an animal finds favour in the eyes of the prince or sahib, it is supplied with the food of the favourites already described, and whether it is male or female it soon becomes barren, on account of the organs of reproduction being gorged with fat; consequently, the best horses are withdrawn from breeding, and the artificial selection of man is made to act in the wrong direction —the race being reproduced from the poorer specimens.

I saw a horse suffering from a disease said to be produced by excess of moisture. It took the form of large blotches or swollen raw sores, which may occur on any part of the body, but most abundantly about the legs. In appearance it strongly resembled an undescribed disease which I first noticed among Cotswold sheep, but which during recent years has extended among Scotch stocks.

There is an extraordinary confusion in the minds of natives of the lower orders, such as grooms, in their ideas of kindness and cruelty to the lower animals. While some were being literally killed by overfeeding and care, I found the one suffering from this loathsome disease tied out in the open, and exposed without shelter to the sun or rain, as the case might be, and to the constant and irritating action of flies, which swarmed about and lived on the skinless parts. Although the disease was well developed, no effort had been made to treat it in any way. The animal was suffering severely, but my drawing attention to the fact was received with the greatest astonishment and indifference.

Anthrax in horses is a most insidious form of disease, and appears to be more deadly than is usually supposed, in so far that when it breaks out in a stable all recoveries from minor ailments are set down to recoveries from anthrax, while in reality there is a doubt if recovery is possible from a well-defined attack of the disease. It is practically impossible to say for certain that a disease is anthrax until symptoms develop, such as the little black spots inside the eyelids,[1] and after that all hope of recovery may be abandoned.

[1] Described by G. Durrant of the Army Veterinary Department, Bangalore.

Purpura hæmorrhagica is frequently mistaken for anthrax in horses. *An elevation of temperature* is a most misleading symptom by which to diagnose anthrax, still it is very commonly depended upon when the disease is about. The temperature will rise above that of the quiescent normal condition of a horse by exposure, or a derangement of system from very ordinary causes. Natural exercise raises the temperature. Imported horses are liable to the presence of a feverish condition and an abnormally high temperature.

Treatment.—As in the case of braxy, profuse bleeding, combined with exercise and repeated doses of powerful stimulants, appear to be the main points of a rational treatment. This can only be effectual, or indeed made possible, in the very early stages of the disease, as the blood rapidly becomes thick and turgid, and dark in colour, owing to lack of circulation, and consequent want of oxidation.

Cape Anthrax seems to be more frequently a local affection of the throat and tongue. The Indian form of the disease pervades the system, and affects the blood and internal organs of respiration and alimentation.

Anthrax is most erratic in its method of attack in a stable. It is not usually classed as an epizootic disease, except in India; but there it would appear that subjugation of a number of horses to similar surrounding conditions, and similar food and water, tainted no doubt with germs, is quite sufficient to explain its presence in most cases; and if we add to this the fact that only certain systems, and those only under certain conditions, are liable to contract some forms of disease, we have a sufficient explanation of its workings, without appealing to anything in the form of contagion, in the usual acceptation of the term.

To leave work animals uncastrated is a decided disadvantage, as has been shown by experiments on an extensive scale. Under Indian conditions I can quite imagine, if the pulping process so universal among cattle is not so satisfactory with horses, that the risks in the hot climate resulting from cutting and making an open wound —especially after using the cautery irons—might give rise to the practice of leaving them in a state of nature. **Durrant's method** of simply excising the testicle after lifting and tying the seminal artery, appears to me as one well worthy of extensive adoption. Should the artery break in the case of an old horse, it is not too late to complete the operation by means of the irons.

The efforts by Government to improve **horse breeding** in India have not met with the success that was anticipated. **The reasons** which have militated against it are many. Wet districts, where the soil also becomes wet and heavy, are not suitable. Where rain is abundant, or on the elevated grazing grounds, myriads of minute leeches abound during a few months of each season, and effectually reduce the systems of horses by sucking their blood. At lower levels, and in dry districts, the blood-sucking pest is the tick—*acarus*.

In Ceylon these parasites are so injurious that successful horse breeding is practically impossible, unless the animals are allowed the shelter of a house.

Barrenness.—The extraordinarily small percentage of mares that annually conceive (on an average about one-third of those covered) is one effectual barrier to success in horse breeding. I do not wish to express an opinion as to the why or wherefore, but I might be permitted to hint that the kind of food, or the system of feeding, is more than likely to be at the bottom of it. We have in this country experienced cases of incapacity in bulls, not in virtue of the amount, but on account of the description and quality of cake given to them. We know that a system reduced either by poor food, disease, or the perfectly natural lowering which takes place when an animal is milking heavily, is not usually in a condition which admits of conception. This is merely a plan of Nature to prevent a female with a weakened constitution—though the weakness may be only temporary—from undertaking the production of a creature which she is unable to bring to maturity. **One thing is quite certain,** that by properly conducted experiments the cause could be discovered, and the remedy would not then be difficult to find.

The Officer in Charge.—Government has not always been judicious in selecting the right men to place in charge of their breeding establishments. If it is a *sine qua non* that an officer of rank and position should hold the first place in an establishment, to fulfil functions which an ordinary individual could not fulfil, the greatest possible care should be taken that a specialist in horse breeding be associated with him.

Breeding is a matter in which there is no possibility of securing success by leaving it to chance or placing it under the direction of one who has to gain his experience. A good knowledge of breeding can only be acquired by a few; it is associated with innate qualities which are not widely possessed. These qualities are originally instinctive, yet have to be cultivated in youth, not by hearsay or from books, but by actual practical everyday experience extending over a term of years. A man may "know" a horse well, and be able to ride a horse perfectly, and all round be an authority on ordinary details connected with horses, and yet be totally unqualified to undertake the management of horse breeding. Because a man is a veterinary surgeon, he is not in virtue of that fact in the least degree qualified to be in the position of greatest responsibility in either a horse or mule breeding establishment. The functions of a veterinary surgeon are only capable of being exercised when beasts are in disease. His training as such is all connected with the treatment of disease, not with the principles or practices of breeding, nor with the management of animals in health, except in a very cursory and imperfect fashion. A veterinary surgeon is necessary in a large establishment of the sort, and if he combines the special knowledge which I have indicated, no doubt he would be the best man to bear the chief responsibility, but not otherwise. If these facts were better known and appreciated, not only regarding horses, but in connexion with all classes of stock, very different results might be expected, and very different results would unquestionably be attained.

The results in breeding do not indicate that the class of stallions selected to be taken to India to cross with country-bred mares have been uniformly the best suited to the circumstances. What is wanted is a strong-boned, well-bred, substantial type of sire with good disposition, while not standing too high. Mares are light-boned; although they may be inferior-looking representatives of good blood, they generally belong to that class. A well-bred sire is desirable at all times, but it becomes all the more important that he should possess good quality and breed true to type under the circumstances. **The English thoroughbred** has become converted into a galloping machine, worthless for almost all but racing purposes. **The American trotter** is sprung from exactly the same stock, but having been bred in a different direction, and having retained or even increased its substance, is much more serviceable. **The Cleveland bay** is a good horse of his class, but he has not enough of breeding for the purpose referred to. **The Yorkshire Hackney stallion,** of all British horses, when represented by the larger specimens of the breed, possesses most of the style and quality wanted for the Indian mares. If no mistakes are made in the selection, he will breed perfectly "true." It is well it should be understood that the first volume of the *Hackney Stud-Book* appeared so late as 1884, and although the Society which compiled and issued it have great credit in the efforts directed to make it as valuable and perfect as possible, yet it must be acknowledged that at the commencement of a society of this kind some horses are admitted which, if all their recent ancestry had been in view, would never have been accepted. For some time to come it will be necessary to make inquiry, as regards the presence of constancy of type, beyond the information supplied by the stud-book. No doubt the real English hackney is descended side by side with the thoroughbred from a common ancestor. An oil painting of "an English racehorse"[1]—Vestris, by Whalebone, out of Varennes, dam of Albert—in the collection belonging to the Agricultural Department in the University of Edinburgh, conspicuously resembles extant paintings of noted hackneys of the early part of this century. It must be apparent, however, to most men who study animal symmetry, that in many of the types of the Norfolk bred hackneys there is a strong family resemblance to the cart horses peculiar to the district—the Suffolk punch. I do not think there is the slightest doubt but that the high front action of many of these horses, as well as of many high-stepping roadsters in Scotland, for example, was originally derived from the cart-horse breeds. The cross was made in many instances so many generations back that the animals under discussion breed true to type, and for all practical purposes may be called "pure;" but it must be understood, nevertheless, that although they do pass as horses of pure breed, yet associated with the visible characters referred to, there *may* be correlated some more or less hidden or less easily recognised quality, such as soft or otherwise imperfect feet. In **selecting horses** for breeding purposes, an infinite number of smaller points of what might be called trifling detail

[1] Appended to this name in the old Catalogue is the following:—"The English race-horse has been formed by an admixture of the blood of the lighter horses of warmer countries with the larger horses of England, and, by a long course of skilful improvement, has been brought to combine the properties of speed and strength in the highest degree." The latter remark would require slight alteration to be a perfect description in recent times.

ought to be looked to, and are looked to by successful horse-breeders. Any traces of the external form of the Suffolk punch in a trotting horse, though not in itself directly injurious, and often even pleasing to the eye, *may* be indicative of some quality not glaringly visible which is incompatible with a quick pace. High fore-leg action may be all very fine in Hyde Park or Regent Street, but very high action of this kind is unquestionably a defect when hard and prolonged work is to be done. I should not object to free and powerful hind-leg motions. If the latter qualities be present, little examination of the loins or back are necessary; and after all it is by the hind legs that an animal may be said to propel itself.

Plate XXXVIII. (*b*) shows the type of horse which I believe would be of more service than any other type for the purpose of improving the breed in India. I selected a mare, Ladybird,[1] because I could not for the moment lay my hand upon the photograph of a horse which so fully represented what I wanted. While going, her action in front is free, but by no means high. The style in which she moves her hind legs is wonderfully perfect, both as regards show and speed. The shoulder-blade or *scapula* is not what might be termed strikingly sloping, but what is in my opinion of much greater importance in a horse of this class, the position of the point of the shoulder as affected by the inclination of the *humerus* is very fairly good.

When in America in 1879, as a member of the Scotch Farmers Delegation which went to inspect the agricultural resources of Canada, I noticed with no little astonishment that some of the best American trotting horses had what we would term decidedly steep, and in this respect, according to our lights, defective shoulders, yet their movements

[1] "Ladybird, No. 177.—Foaled 1881. Brown. Sire, Lord Derby 2nd (Burnham's), 417. Dam, Brown mare by Knapp (Couchar's), 399. Height, 15.1 hands. Owner, J. A. Mather, Thornhill, N.B."

were not impeded in consequence. **The explanation** was fully brought home to me by the admirable paper of James Howard, M.P., of Clapham Park, Bedford, published in the Journal of the Royal Agricultural Society of England in 1884. I am indebted to this gentleman for permission to prepare the following engravings from his illustrations, and to draw attention to his remarks.

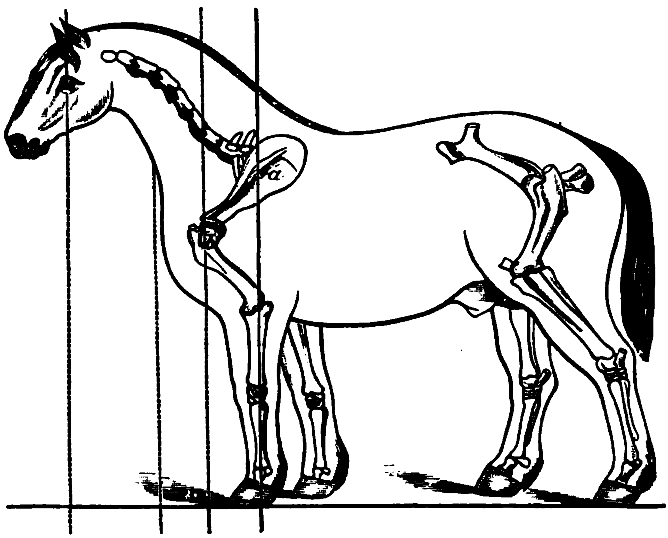


FIG. I.

The fact of greatest importance which is there shown is that, though not generally known or acknowledged, the position of the *humerus* in a horse's shoulder is of far greater importance than the position of the *scapula*.

Figure I. shows a *humerus* (*b*) which inclines much too far back, and forms almost a right angle with the scapula (*a*). In Figure II. the *humerus* (*b*) is more nearly perpendicular; the fore limb is joined on further forward as regards the body, and placed so that it has greater freedom of action—not necessarily greater freedom in lifting perpendicularly, but greater freedom in its forward motion, which as a matter of usefulness is the point of importance. Not only is there greater freedom, but there is greater strength ; and

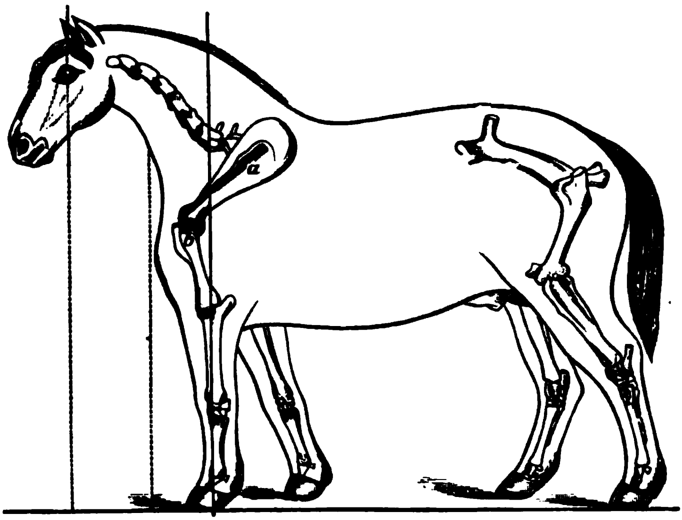


FIG. II.

the recollections of the steep but powerful shoulders of the American horses would induce me to believe that a steep scapula, provided the humerus is rightly situated, is rather an advantage than otherwise when an animal with a heavy body has to travel at high speed.

CHAPTER XI.—HORSE AND MULE BREEDING.

Demand for Mules—Horses from New South Wales—Method of Breeding in India—Variety of Classes of Animals wanted—Vital Importance of Securing Foals at Weaning—Native Objections to Mule Breeding—Horse and Mule Rearing Farms—Importance of Training Animals to Eat Varieties of Food—Additional Conspicuous Advantages of a Good Method.

HORSE **breeding and mule breeding** are classed together because I am of opinion they would be best carried out on the same system in India, and because I believe that circumstances make it necessary that Government should encourage both simultaneously.

A demand for good mules has sprung up since it has been decided to use mules in place of bullocks in certain branches of the military service. For Government to encourage mule breeding without taking care to protect horse breeding in the same districts would be like the proverbial "slaughter of the goose that laid the golden egg." Mule breeding, as regards the breeding capital of stock, is a non-productive expenditure of natural energy, and so far as it is unnatural in this respect, it demands special precautions to prevent its own extinction.

The abundant and excellent supply of horses from New South Wales places Government in an independent position in the matter of horse breeding as regards remounts; but Government has other interests to serve than this, which is directly selfish. The interests of the nation demand attention, inasmuch as horses ought to form an important and remunerative branch of the live-stock of the country; and, moreover, horse breeding is a necessity for the support of mule breeding. Besides, animals bred in the country, other things being equal, will always maintain a greater value than imported ones when put to extreme climatic tests.

One right or rational method of meeting the requirements seems to exist, but at the same time there are many spurious plans which have been tried, and which have failed. The Stud Commission appointed by Lord Northbrook in 1872 declared, that "practices adopted in the studs respecting the breeding and rearing of young stock are undoubtedly at variance with all the principles admitted as sound by practical breeders in this country; and although such practices have been repeatedly condemned by local inquiry in India, they appear to be chronic in the Government establishments." In justice to the present officials, it must be added that better results have attended the efforts of the Department of Horse breeding Operations established since that time. I have no reason to believe that this department is at fault, considering its facilities; but had the available resources of the country been put at its disposal, very different results might have been achieved.

I enumerate the classes of animals wanted before going into details,—(1), Stallions of good quality to be sent down into the districts with the primary object of securing good, sound, serviceable mothers suitable for breeding artillery mules and keeping the stock of mares from degenerating; and, in the second place, of getting a certain number of useful home-bred army remounts; (2), He-asses, also to send to the mule breeding districts; and (3), Suitable mothers, to produce all the various classes of animals specially or incidentally named.

It is without explanation obvious to a practical man, that Government must possess a self-supporting stud capable of breeding all the horse and donkey sires that they do not find it advantageous to import; but further than this I do not think existing circumstances warrant the increase of the numbers of the breeding stud, with the object of producing animals fit to go into the military services.

The amount of personal supervision which demands, as a rule, a personal interest in the work associated with mares immediately before and after foaling, precludes the possibility of Government making the breeding of ordinary animals on a large scale remunerative or satisfactory. For this reason the mares should belong to the natives throughout the regions which have a suitably dry climate for the healthy existence of horses, and have at the same time soil which does not get waterlogged and spongy. By this system each mare and foal would be specially attended through the critical stages of the season of parturition by the person who had the greatest interest in their well-being. The sum total of this personal attention and the fruits that it would bear would be far beyond what the Government or any one could purchase in the labour market.

It is a matter of vital importance for the success of the system, *that the young animals should pass into the hands of the Government officials at weaning, to be kept on well-appointed grazing farms or nurseries, under the management of agricultural experts,* where they would have a regular supply of suitable food secured to them. The period after weaning is most critical, as if a foal loses its "suckling" flesh through a want of proper nourishment, its muscles never develop to the natural extent. There is a parallel in the case of a fat steer which has by mismanagement lost its "calf flesh,"[1] having an excess of fat over lean in its carcass. I believe the periodical scarcity of food, affecting the development of the muscle of young horses, has much to do with the frequently unnatural, thin-fleshed condition of native horses.

[1] Not fat, for the flesh of a so-called fat calf or a fat foal is really not so much fat as young muscle.

Animals in low condition are brought even lower by internal parasites, which thrive in abnormally reduced systems. Again, of those horses which escape the consequences of bad feeding while young, the best, if they are really very good, are bought for the stables of Rajas, who frequently destroy them for breeding by mistaken kindness and overfeeding.

I have no hesitation in saying, that Government will never have satisfaction in their efforts to improve the breed of horses or to secure serviceable mules until provision is made for receiving the foals at weaning into farms set aside for the purpose. The mare and foal should be taken to a receiving centre, and the foal delivered over as it is removed from its mother. This would be no additional cost or trouble, as the man who brings a young horse to a Government nursery has to return home, and in doing so he could conveniently take the mare with him.

In some parts mules are looked upon as **unnatural,** if not unlucky, and a man who breeds a mule is laughed at. In an unpopular business of this kind, the only chance of getting it started is by offering quick returns. A man does not mind being laughed at for six months or so, if he knows he is to secure a substantial reward at the end of the time; but few have the courage to enter upon a three or four years' term of personal sacrifice of feelings for a reward made risky by the remoteness of possible realization.

To go still further, if increase of numbers is an important object, the best possible encouragement would be given to it by relieving the breeders of their young stock, thus enabling them to keep greater numbers of brood mares.

Good prices paid for good beasts, besides handsome **prizes** offered as reward for excellence, would be all the additional inducements necessary to develop more extensive and better practices of breeding.

Horse and Mule Rearing Farm.—It should be regarded as an absolutely essential condition for success that the officers placed in charge of horse and mule farms must be men of wide practical experience in the work they are asked to undertake, not only in the management of horses, but also in the management of the grass or crops grown for their food, and of the land on which these are cultivated. No gentleman would think of selecting his butler in place of his coachman to purchase or choose for his inspection a suitable horse for his purpose. No one but a maniac would think of going to his bootmaker to order a pair of new trousers! Nevertheless, it is a fact that one's shoemaker would achieve quite as great a success in "cutting" a new dress coat as an inexperienced officer, even of transcendent ability, would do in the management of a horse breeding and rearing establishment.

One of the most important functions of a farm would be the training of the animals to consume, without hesitation and loss of time and condition, all common sorts of forage, and, after a time, all sorts of ordinary grain. I believe that training in this respect is equally as important as training to work. Although it is judicious to accustom mules to eat all kinds of wholesome grains, it is not necessary when they are not at hard work to feed them highly. An officer of wide experience told me he had kept both battery and commissariat mules of 13½ to 14 hands in very good order on fodder made up of bhusa and lucerne (*Medicago lupulina*) hay in equal proportions. There is no reason why silage should not form part of the fodder given in the dry season; and if there are real objections to giving silage to horses or mules which have not been accustomed to it, this would be overcome by early training. Some beasts get into the habit of bolting their food, especially if small grains like *kulthi* are used by themselves. There are ways of mixing rough dry ingredients to prevent this, at least to a large extent, without going to the expense of cooking, when that cannot be conveniently accomplished.

There are several conspicuous advantages brought about by the adoption of this course besides that connected with the food and those previously mentioned :—

(1.) Animals reared under community arrangements always thrive better when closely associated with each other in large numbers than do those which have been brought up separately when placed in a like position.

(2.) The tempers or dispositions would not be spoiled by the petting of herd-boys.

(3.) The absence of hobbling or tethering would allow the muscles to become developed by exercise.

(4.) Government could regulate the castration satisfactorily, and afford to provide veterinary skill when necessary for the treatment of ordinary ailments or diseases.

I have had the opportunity, since writing the above, of seeing a communication on this subject to the Chief Secretary to Government Revenue Department, from the acting Director of Land Records and Agriculture for Bombay. I fully concur with his suggestions, with but one exception —the proposal to leave the young horses in the hands of the ryot till 1½ years old. As I have pointed out, the great injury is done immediately after weaning. I strongly support the recommendation that the regulation relating to the branding of mares should be done away with, as a most likely means of raising the average standard of horse breeding.

Plate 39.

RED SHEEP AND A GOAT SHEWING PAP-LIKE PENDICLES.

GOATS IN JUNGLE (TUTICORIN).

CHAPTER XII.—SHEEP, GOATS, AND PIGS.

Sheep—Varieties—Earth-Red, Hairy Sheep—Eat Excrement—Black Sheep—Coimbatore Sheep—Sheep seen near Baroda—The Gangetic Valley and Dárjíling—Smallpox—Goats—Group at Tuticorin—The North-West Goat—Goats widely Distributed—Active and Restless Disposition—Objected to in a Forest—Utility of the Goat—The Flesh of Goats and Sheep—Their Skins—Pigs—Black in Colour—Imported White Pigs in Ceylon.

Plates XXXIX. and XL.

THESE **two species** of animals, respectively *Ovis* and *Hircus*, though so different in constitution that they do not interbreed,[1] are yet in appearance so like each other in some respects, and are so much associated together on account of possessing similar habits of life, that to attempt to describe the one without the other would end in doing justice to neither.

SHEEP.

The Madras, hairy, earth-brown or red sheep is the variety most distinctly and peculiarly Indian. It is represented in Plate XXXIX. The same peculiarity of short and drooping hind-quarters and want of flesh on the thighs, noticed in cattle, is also present in this breed of sheep. It is to be seen generally in South-Eastern and Southern India, on the poorer tracts of what may be termed sheep-grazing jungle. In that tract of country lying south of Madras city, where the red breed of cattle is found, there is a wonderful correspondence in the colour of the reddish

[1] Cases of hybrids appearing are recorded, but I should question the accuracy of the observations.

soil and of the three prominent breeds of live-stock—cattle, sheep, and goats. The two latter are so like each other, going as they do in flocks together, that it is difficult at first to distinguish the one from the other. Closer examination shows the goats to be rather deeper and richer in colour, and to have more of a glossy sheen on their coats than either the cattle or the sheep. *Goats* are always lively and elegant in their movements, carrying their heads and tails in the air. They seem rather to enjoy the hot sun than to be oppressed by it, and on going to pasture, or even while grazing, they lead the flocks. This in its way is an advantage for the sheep, as by following the goats, as they naturally do, they get more exercise than otherwise. *Sheep*, again, are lazily inclined, and go about with their heads and short tails drooping. They try to shade themselves from the sun either behind neighbours or below trees. The solitary sheep lying in Plate XL., while all the goats are on the move and restless to get off to their pasture, brings out most naturally the character of sheep in contrast to that of goats. The photograph, the original of this Plate, was taken in the poor sandy jungle land near to Tuticorin.

When sheep are hard up for food, as in seasons of drought, they will pick up human excrement and all sorts of filth about villages, while a goat will die rather than touch it. In the possession of this habit of cleanliness the goat stands alone among all the cloven-footed domestic animals of India.

A number of the red-brown sheep have black heads, legs, and bellies, and, as seen in Plate XXXIX., broken colours also appear, but probably these are the result of crossing. Only the males have horns, which are about the strength of and somewhat resemble the horns of a three-year old Scotch Black-faced Highland wether.

Black and Red.—South of the region of universal red-haired skins, as south of the Pennar River, the colour of sheep and goats is divided between red and black, each alternately predominating in different districts. The change from red is not nearly so abrupt in their case as in the case of cattle.

Black Sheep.—About twelve hours by rail from Madras, in the direction of Bombay, large black sheep predominate, and are numerous, especially in the neighbourhood of low rocky hills. Goats there are relatively small-sized.

To the west, in the Southern Maratha country, sheep are mostly black, but white patches, and even white sheep, appear at times. The goats resemble them in this, being mostly black, though a few are white, and some are grey or broken coloured. The colour of the skins of the darker varieties of both goats and sheep generally approximate to the colour of the hair. The same correlation does not always extend to white goats, as black skins also exist under white hair. The colouring pigment, however, is superficial, as in the process of tanning, after coming from the lime bath, the skins all become white, irrespective of the colour of hair or colour of cuticle.

In the neighbourhood of Coimbatore, a rich district noted for its sheep, stretching up to the base of the hills on the way to Utakamand, I saw a breed of beautifully pure white-wooled sheep, with black heads and necks. In rare cases the black extended on to the shoulders or even to half of the body. Stray specimens of this breed were to be seen now and then far up in the Southern Maratha country. Where the character of the land to the east changed abruptly to hard and poor soil the breed of sheep changed with it to the inferior, but no doubt hardier brick-brown variety.

In going north by the Baroda line of railway, I saw numerous flocks of white sheep in the district lying near to Mount Abu. The goats amongst them seemed to have larger ears than those further south.

From the line of railway passing east through the

Gangetic valley, and also through the rich grazing **lands running north from Calcutta** towards Dárjíling, flocks of sheep may be seen, perhaps 100 to 200 in number, about half black and half white.

Near to Dárjíling I found a small flock of 60 or 70 **English sheep**, which twelve years before had been bred from South Down rams and Leicester ewes. The surroundings did not seem to suit them, still they might have looked better had they not been subjected to "in-and-in breeding" for such a length of time. At certain seasons they were liable—especially the younger ones—to "scour" and become weak, and sometimes to die in considerable numbers. I have no doubt this was produced by internal parasites. The remedy in that case would be repeated doses of turpentine. Fortunately, under the circumstances, maggots were unknown, else it would have been practically impossible to have prevented the sheep from being literally eaten alive. Leeches also do much injury, both by causing annoyance and weakening the system by sucking the blood. A number of the sheep had horns, and the wool was coarse and hairy, most unlike the quality of wool that a cross flock of the same description would produce at home. The tendency to hairiness of coat is a characteristic common to mountain sheep. The assumption of it by fine wooled sheep indicates that local conditions have much to do with its production or development. On the hills sheep have to be housed at night to protect them from leopards and jackals; this adds considerably to the expense of keeping.

It would be vain to try to improve Indian sheep by crossing with those from Europe.

Smallpox—called "*Matah cheehuck* (Bengal), *Debee* (North-West Provinces), *Burree* (Punjab)"—is a contagious disease which at times cuts off nearly the whole flock, while under other circumstances, possibly resulting from the type being milder or the surrounding conditions being less favourable to its development in a serious form, only ten per cent. might die. The disease much resembles smallpox in the human species. The eruptions on the skin are most abundant on the bare surfaces of the under parts of the body. Careful management and nursing is an important portion of the treatment. I heard of large numbers having died of this disease in the great sheep districts of Mysore.

GOATS.

Plates XXXIX. and XL.

Plate XL. represents a group of female goats belonging to the region around Tuticorin, in the extreme south of India. Some have no horns, and others have small horns set on to the crown, wider apart and spreading more widely than the horns of our British goats. In the centre of Plate XXXIX., photographed in the butchers' market in Trichinopoli, is a goat with the head held up by the horns to show a pair of peculiar looking, little, pap-like pendicles, covered with short, fine hair, frequently seen high up on the neck or throat, and said to be an indication of good milking powers. My friend Joseph Thomson, author of *Masai Land*, tells me he has noticed this peculiarity in African goats. Some twenty years ago, I remember having seen a growth of a similar kind on the throat of a white sow said to belong to a Russian breed.

The goats of Southern India are much smaller and poorer than the goats of the North-West.

A North-West Goat, with his strut of independence and portly bearing, justly calls for a greater share of admiration than any domesticated animal to be seen in India. His build is altogether more massive and his hair is longer and more flowing than that of the goat from the South. The ears are long, large, and perfectly pendent. The colour of hair is most frequently black, or black and tan; but some are white, black and white, mouse-coloured tan, or varieties of spots and speckles.

The goats seen from the railway to the south of **Jabulpur** are also large and handsome. **Those seen** on the journey from **Bombay** to **Madras** are smaller and mostly black. On the **south-eastern coast** of Madras, as about the neighbourhood of Shiyali, black also predominates.

Goats are widely distributed and extensively kept in India wherever there is abundance of waste or jungle land. They are generally associated with sheep and kept in flocks—perhaps 100 or 200 together—constantly attended by goat-herds. **The relations of the flock** with the shepherd or goat-herd are much more intimate than in this country, and the intimacy of the dogs in attendance is closer still. It is usual to see the dog walk quietly in the centre of a flock like one of the number.

The restless and active dispositions of goats make them the leaders, and sheep depend upon them for guidance in the search for food. It has been asserted that when sheep have been pastured apart from goats, they did not thrive in a satisfactory fashion, as they would not spread about and feed properly. This is what might have been expected, and is exactly what happened in olden times in this country when sheep were made to follow a bell-wether when the wether was removed. Sheep are now trained to graze without a bell-wether; but although it might be possible to train Indian sheep to depend more upon themselves, I believe it would, on account of their soft natures and the hot climate, be much more difficult.

Goats are seriously objected to by forest officers on account of the injury they do to trees. Sheep have also been blamed, but often unjustly. Goats are very destructive, especially among young trees if they can get at their terminal shoots. They get up on their hind legs and forage among the lower branches of the jungle trees, seriously injuring the twigs and bark. I have no doubt but that their long legs and long necks have been gradually developed by Nature to suit them better for their peculiar method of collecting food. It is most interesting to watch how upright they can stand with perhaps only one forefoot resting on a slender twig; and it is astonishing how far up they can reach when necessary. The goat-herds also do damage to trees by breaking down the higher branches to get at the leaves and pods.

Utility of the Goat.—Goats and sheep are both largely employed to **manure** the land by confining them on certain areas, on which they deposit their solid and liquid droppings.

Goats are also kept on account of their **milk**, which is prized as being a light and wholesome food. In milking, the milk is generally drawn from behind, between the hind-legs, as sheep used to be milked in Scotland down to some thirty years ago. Though the ancient custom is surrounded with sentiment,[1] the practice, to one who has seen it, does not appeal to our ideas of cleanliness as being quite satisfactory.

The flesh of both goats and sheep is now largely eaten. The more advanced Brahmins are even getting over their religious scruples in this respect. Goats and sheep being able to live through a season of drought which would be fatal to cattle makes a due regard for their welfare a matter of importance in India.

Sheep and goat skins are tanned [2] and sent to London, and also, in recent years, largely to the United States of America. They are bought by curriers, dyed, dressed, and used in bookbinding, glove-making, and generally in fine leather work.

Sheep skins are much the less valuable, being sold in Southern India in the green, salted condition, by the

[1] "I've heard them liltin' at the ewe milkin',
Lasses a liltin' before dawn of day."

[2] In Hemple's tannery near Dindigal, where the native system, improved by European devices, is practised, 30,000 to 40,000 skins are turned out *per mensem*. The men employed vary in number from 200 to 250, and receive monthly wages of from Rs. 4·8 to Rs. 15.

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flock owners to the tanners for Rs. 30 to Rs. 75 per 100 skins. *Goat skins* also vary much in quality, not only owing to the way they have been preserved, but also owing to the sex and condition of the animals from which they have been taken. Skins of females are poor in substance. Good skins range in price, while raw, from Rs. 70 to Rs. 180 per 100, or about As. 6 per lb.

PIGS.

The universal pig in India is the *Sus Indicus*. The domestic variety is usually represented by small but by no means badly formed specimens, black in colour, and, like the buffalo, with little hair,—excepting a ridge of strong bristles up the back. They frequently have white feet, and at times a little patch of white on the head or tail. These white markings clearly indicate the origin of the white feet, star, and tip of tail now forming a point of importance in the improved Berkshire breed. Pigs are the common village scavengers, and as is the case with those which have been made to tend themselves, they are extremely active, and their noses are long. They are usually lean, big-bellied, miserable-looking, and seem to work hard for their food without much success. They trot lightly like a dog, with their noses on the ground, always on the hunt, to make certain that nothing in the shape of food is missed! The large belly is the natural result of living upon poor bulky materials, which have to be consumed in large quantities to supply sufficient nourishment.

In Ceylon the same breed of pigs exists, but in addition there are white specimens. They may have been introduced originally from England, but now, with the exception of the colour, they strongly resemble their black neighbours.[1]

[1] In the coast districts of Bombay, on the farms of Christian cultivators, the descendants of white pigs imported by the Portuguese may be seen, but generally the Mussulman's abhorrence of the pig is shared by all classes.

In the establishment of a wealthy native gentleman I found a number of well-bred white Yorkshires in a most healthy and thriving condition. When sheltered from the sun and allowed plenty of water to keep their yards muddy, they did not seem, even when large and fat, to suffer from the heat nearly so much as I should have expected.

CHAPTER XIII.—SOILS.

Area of India—Distribution of Soils according to Geological Formations—Alluvium—Deccan Trap—Archæan Rocks—Gondwana Rocks—Vindhyan Rocks—Alluvial Soil—Black Cotton Soil—Hardness of Soils—Stones—Question of Exhaustion—Action of Rain-Water—Support of the Annual Yield of Crops—Temporary Fertility: its Importance—Drains upon the Resources of Temporary Fertility—Exportation of Bones—Organic Matter in Soil—Supply of Combined Nitrogen from the Air—Influence of Lightning—Humus—Usar or Reh Soils—Their Remedies—Explanation—Usar at Cawnpur.

THE area of India, according to the *Statesman's Year-Book*, 1888, is 1,574,450 square miles. Of this 509,730 square miles belong to Native States.

The soils vary extremely in most of their prominent features. In fact, India as regards soils, climates, and crops may be said to have every conceivable variety more or less represented. Looking for a moment at the main features of the country, we find in the north the great Himalayan Mountain Range. To the south of this, as may be seen from the green coloured area in Map No. II., is a great belt of low-lying **alluvial deposit** in the valleys of the Ganges and Indus, and still further south extends the so-called plateau of the Indian Peninsula (coloured brown) rising to a "mean altitude of between 1000 and 2000 feet, with isolated peaks 6000 feet above the sea." This is girdled on the seaboard by a narrow fringe of low-lying alluvial land, which here and there expands, and at times juts out into the continent along the courses of the larger rivers.

In round numbers about one-third of the area of the table-land consists of the **Deccan Trap**, which is now supposed to be the origin of the famous black cotton soils of the Bombay Presidency and the Central Provinces. **The Archæan Rocks**, lying mainly to the south and east of the Trap region, cover a much wider area than the last. These three geological divisions embrace by far the greater part of the country. **The Gondwana Sandstone Rocks**, in which Indian coal is found, lie to the north-east of the peninsula in the regions through which the great rivers pass. **The Vindhyan Rocks** appear in patches. They are also of sandstone, and are of so little importance that they call for no further description.

The alluvial soil of the Gangetic Valley varies much in texture from the north-west, in the higher reaches of the rivers which deposited it, where it is sandy, to the lower plain or delta at the mouth of the Ganges, where, as one would naturally expect, the finer divided soil particles have found their way, and have accumulated so as to form soils of a dense and close texture. With the exception of a portion of the area to the west where the climate is disadvantageous, and where the conditions of fertility are replaced by those of a desert, the alluvial soils of the north are celebrated for their fertility, and the dense mass of population which they are enabled to support, amounting in the North-West Provinces and Oudh to over 400 per square mile. As pointed out under Irrigation (Chap. XVI.) this alluvial belt, except in the desert region, is abundantly watered, having an underground reservoir of water from which the population, where not within reach of canals, are enabled to draw by wells with, in most places, comparative ease. **The black soil**, again, is not extensively irrigated. It is too dense, and irrigation tends to bring up salt which in many places underlies it. Fortunately, black soil does not require water so much as ordinary soils, as it possesses an extraordinary power of retaining moisture during the dry weather, while yet great cracks appear. These are more fully described in the chapter dealing with native harrows.

Further, the great crop—cotton—and the other usual crops are mostly grown during the rains, which begin early in June. It varies much in depth, as may be observable from railway cuttings, from a few inches down to 17 feet or more. The shallow parts do not retain the moisture well. I saw patches of a covering of black soil pretty extensively represented, overlying the red Archæan rocks of Southern India. It frequently happens that the whole of the black layer gets washed away from land lying close to a stream. I noticed that the natives took the opportunity, where convenient, of mixing the one with the other by top dressing.

Soils get so hard in India that it is a matter of impossibility to plough them until the early rains come to break up and pulverise the surface. Irrigation is frequently employed to bring about this condition artificially, and in some of the low-lying tracks of Southern India, where the south-west monsoon passes over and does not break till it reaches the hills, moisture is absorbed from the air to a sufficient extent to enable the soil to be worked before rain actually falls.

Although there are no stones in the great alluvial track nor in the deeper varieties of the cotton soils, yet stones may be seen abundantly where the soil is derived from hard rocks, as is the case with many red or brown soils in Southern India, or where the broken down particles from certain parts have got washed to a lower level. The natives rather appreciate the presence of stones on this land.

One old and very important question with regard to India still continues to be asked: "Is the fertility of the soil being exhausted by the native practices that have been going on for thousands of years?" My unqualified answer is No. By the soil I mean the layer of crumbled rock particles which spread over the surface more or less thickly according to circumstances. In dealing with rice-crop land, I show that the little loss of fertility sustained by the growth of rice is counterbalanced by the sediment deposited by the waters with which it is abundantly supplied from higher levels. On rain-crop land the action is different, but in the same direction. I take for illustration a rich deep soil, which is undulating, as all rich soils are more or less. In addition to the circulation of soil between the immediate surface and the subsoil, to be fully explained when treating of implements, there is an eroding action or a washing, in some cases with extreme slowness, of fine soil particles from the higher to the lower levels. It may be that a given particle only moves down a slightly inclined surface a few inches each year, but when we consider the aggregate of this washing action in a space of 100 years, which is as nothing to the antiquity of the Indian continent, we begin to appreciate the effect. The ultimate result is, that a certain amount is washed in due time to the sea and lost, but this is by no means a measure of the action of washing. By far the greatest amount of the land moved year by year by water is retained on a lower level, and thus we have two descriptions of surface—the washed and the warped. The latter is top-dressed at the expense of the other—say, for illustration, that in ten years twenty tons of earth have been washed off one acre of land, one ton has been completely lost,—carried off to the sea,—while nineteen tons have been spread over an acre of land at a lower level. The soil particles carried down and rearranged at the lower elevation are during the process more fully prepared to supply plant food.

When passing through the black soil country, I took much interest in noticing the results of the action of the rain-water on the soil near by the railway cuttings, which had artificially produced unevenness of surface.

The annual yield of crop from a field is derived from the gradual decay or splitting up of soil substances, and the liberation thereby of the food of plants locked up in them. It is not a matter of the plant helping itself, as it were, in an unlimited kind of way to the contents of the storehouse of soil wealth, but it has to wait until Nature presents that food in proper form in her own way. The hand of Nature cannot be forced in this direction, and therein lies the stability and safety of soil fertility.

Looking to the result on the denuded land, we find that before the action began, as well as now, the crop roots annually occupied the soil to the depth of, say, two feet, consequently for every 20, 50, or 100 tons of earth washed from the surface, say in ten years, we have a corresponding addition made from the unoccupied sub-soil; the sub-soil again recruiting itself by decay of the subjacent rocks. It is only where surface water washes away more soil than the decaying rock can make good that we have a lowering of the surplus stock of soil substances, and after a while a reduction in fertility. The level of the continent is thus being lowered by very small degrees, but this does not affect its fertility for the time being. By cropping in the ordinary way the native fertility of a soil cannot be lowered.

Temporary fertility, the qualities possessed in virtue of some accumulation of material useful to plants, may be dissipated, but when this is gone, no system of cropping can reduce the land to a lower point. The greater portion of the land in India which is not newly broken in annually produces its minimum yield. Where declining fertility has been recorded, it was no doubt due to the loss of temporary fertility which had accumulated during a period of rest.[1]

[1] Quoting from Chisholm, the Bilaspur Settlement Officer, *The Famine Commission Report,* Appendix, vol. iii., page 194, says:—"When fresh soil is broken up for rice cultivation the ground can never be got into proper order during the first year, and the yield is less than in the old fields. In the second year the return rises about an eighth above that of the old fields, and increases gradually year by year until the fifth, when it reaches 50 per cent. above the yield of the old fields. It then commences to decline, and in about another five years has subsided to the level of the old fields, and at that level it remains unchanged apparently for ever. Many fields, for instance, are believed to have been continuously cultivated for the last 150 years and more, yet they are in

The practical outcome of it all is simply this, that as regards the soil ingredients supplied to plants there is annually a certain given amount provided by Nature which, by proper management and good systems of cultivation, can be made of greater avail to crops than when bad systems are employed. We may fitly compare the stock of soil substance to capital and the yearly benefit derived from it to the annual interest. There is a further question of vast importance in this matter. There is such a thing as the accumulation of yearly interest to form additional capital, which is additional wealth, and produces additional interest or income to the careful owner. The temporary fertility of soil corresponds to the second capital, and the proceeds to the additional interest derivable from it. This is the fertility which is made by saving it, so to speak,—that which is supplied by manure added to the soil or by crop residues in the soil. This is the fertility which science explains how to conserve,—the fertility which, in virtue of so-called artificial manures and enlightened system of rotation and general management, has placed English agriculture in the foremost rank of the agriculture of the world. This is also the fertility that the soils of America are losing by continuous growth of wheat on the same land ; and, finally, this is the fertility that India should strive to foster. Recent practices induced by European intercourse tend to lower the standard of this fertility below that under ancient native practices. At least two serious drains upon it have been established :—(1) the export trade in wheat and other grains and seeds to Europe, and (2) the export trade in bones. When the crops were all consumed at home the ash ingredients were, with little loss, returned to the earth either intentionally or unintentionally. Now there is a steady drain due to export. Although the bones of

no way inferior to land reclaimed from the jungle but 15 years ago." It is further shown that dry crop land follows the same rule, but comes to its lowest level of fertility more slowly than rice land.

animals have rarely been used for manure by the natives of India,[1] yet they were not bodily removed, but carried back to the fields by jackals and through accidental means, so that, though not taken advantage of as manure by the natural owners, yet they were not lost to the country. Although it may take some time, these drains on the resources of temporary fertility will unquestionably in the end tell with serious consequences on the yields from Indian cultivation.

The organic matter in a soil—the *humus*—usually contains the greater part of the temporary fertility. It is formed from crop residues or remains of plants that have occupied the land in previous years, and contain in their substance not only mineral matter which has already entered into plant circulation, but also store up for the use of succeeding generations of crops combined nitrogen (worth from £70 to £80 per ton), the most valuable of all manurial ingredients, because so little available in proportion to the demands of vegetation for it. The stock of combined nitrogen has been, no doubt, at some time or another derived from the free nitrogen of the air, but our most competent authorities, after much laborious and lengthened experiment, are bound to confess that science is not yet able to explain the entire process by which free nitrogen is combined, to account for all that we find in our soils. It has been computed at Rothamsted that about 5 lbs. per acre per annum is the amount of useful nitrogen that the rain and aqueous vapours bring down and carry to the roots of plants in the open or rural districts of this country. It is believed that this nitrogen is combined from its free and valueless state by electric action, which is most intense during thunderstorms. In India there is infinitely more lightning, especially in the early part of the south-west monsoon, appearing often

[1] And, apart from their religious scruples, this is not to be wondered at, when we remember that it was only about 1825 that bones were first used as manure in this country.

without an accompanying storm. I have repeatedly counted as many as twelve flashes, from what appeared to be one large cloud, in the short space of a minute; and I am confident, from the dark green colour of the straw crops, taken in connexion with the fact that soil in India under cultivation is remarkable for the small amount of nitrogen in its substance, that the natural supply brought down, by the *early* rains more especially, is in excess of the 5 lbs. per acre which is now being supplied to the land in this country. If there is an exceptional natural supply of nitrogen, which, to my mind, is most probable, though after all it is only a matter of conjecture, there being no agricultural chemist in India who could settle such questions, the Indian wheat grower has a wonderful advantage over the British farmer, and even over the American wheat grower, whose supply of nitrogen is in a great measure drawn from vegetable accumulations in the virgin soil, and which is, in consequence of a system of close cropping, becoming exhausted. Since these views regarding an extra supply of combined nitrogen in India were first made public, Sir John Lawes has been good enough to point out to me that, by some experiments made in reference to this matter in Australia, it was shown that the known air supply of available nitrogen was even less than in the United Kingdom. I may not be correct in my assumption as regards the source, but I feel confident that the appearance of the crops warrants the assurance I feel that there is an exceptional supply of nitrogen from some quarter.

Humus has other functions to perform in soil besides supplying food—its mechanical action in regulating the density of soil, and its capillary action or its power of absorbing and retaining moisture.

Its presence is extremely important in a certain class of soils found extensively about the centre of the Gangetic Plain, and which are defective in mechanical consistency. **The reference is to the Usar or Reh soils,** which are practically worthless. Crop plants will not grow upon them because the immediate surface is poisoned with an excess of soluble matter, mostly soda salts: the sulphate being in greatest amount, but associated with a considerable quantity of common salt. Owing to the defective mechanical condition of the soil, there is in a climate like India an excessive evaporation from the surface. The soluble salts are brought up from the body of the soil, where, if they were allowed to remain, they would in many cases prove quite innocuous. So abundant are they on the surface that they crystallize out, and form a crust or layer termed an efflorescence. This incrustation and consequent barren condition is not uniform over a large area, but is more or less patchy, giving a map on which the degrees of saltness are represented in different colours, a marled or broken appearance. Land slightly elevated is not so seriously injured as that which is hollow or low-lying. It has been a surprise to some (although when one understands the nature of the action there is nothing wonderful about it) that good land and worthless land are found side by side in the same tract of country.

It has been said that irrigation is harmful, as of course all water flowing on the earth's surface for some time contains salts in solution which, if the water is all evaporated, will be left to swell the bulk of residue. It was argued, for example, in the case of sugar cane getting in a season about 2 feet of water which was all evaporated, that in fifty years the soluble salts would perceptibly and injuriously increase. It is generally understood that there is a considerable river of water filtering through the substrata of the Gangetic Valley supplied and pushed forward by rain-water soaking down from the mountain regions of heavy rainfall.

This at certain seasons must carry away some of the salts brought down by irrigation waters, and, in many cases at least, where there is free circulation of water in the soil, check the accumulation of soluble substances.

Almost every conceivable means has been tried to permanently overcome the injurious effects of the excess of soluble salts. The results have been unsatisfactory, simply for the reason that the original cause of Reh is an inherent mechanical defect in the soil. This can be overcome temporarily by elaborate and expensive means, which cannot at present be undertaken on a large scale. Mahomed Hossain has in some experiments carried out at Cawnpur, by the liberal use of dung, made quite a difference in the character of some Usa soils. Maries at Darbhangah by growing trees, particularly the rain-tree, *Pithecolobium dulce*, Bth., but also the white sirris, *Albizzia procera*, Benth. (both belonging to the Leguminosæ), on salt land, has restored its power of growing crops for a time, but to retain this induced condition it is necessary to keep the land under heavy crops by manuring and liberal treatment.

Explanation.—It was believed by some that the trees had a great power of making use of salt, and that they took it up and retained it in their substances, but, as a matter of fact, a moment's reflection in the light of a knowledge of the truths relating to tree life must dispel any idea in this direction. The ash taken up by any tree is extremely little indeed—the merest fraction in comparison with the body of the soil from which it draws its mineral supplies. Again, there are very few plants (and the trees under discussion do not belong to them) which take up soda salts in any considerable quantity.

The action of the trees, in the first place, appears to me to be quite mechanical, and brought about by a large amount of evaporation from their leaves. Many small root tendrils fill the soil beneath the trees, and absorb water from some distance below the surface to make good the loss to the tree by leaf evaporation. In this way the moisture is not allowed to evaporate to the full extent from the top soil, but is got quit of by a method which does not admit of the soluble matter coming up to the surface to do the injury.

As years pass the decay of those roots in the soil adds to its power of retaining water, and no doubt also a certain portion of soluble salts, though not the soda salts, are locked up for the time in the accumulated *humus*.

In the Usar tracts at Cawnpur I found the milk plant, *Calotropis gigantea*, R. Br.,—the Madar (Hind.),—growing luxuriantly even on the worst places, and exercising an influence for good in the same direction as the rain-tree. I dug down, and found the leading roots had descended nearly 3 feet to the subsoil impervious pan or clay (till) band.

I have no doubt but this indurated pan was both literally and metaphorically at the bottom of the Usar tract referred to.

It is certainly most necessary to find out the different methods by which Usar land may be reclaimed, so as to be ready when required; but I have come to the conclusion, after careful inquiry and inspection of it in the country, and after perusal of what literature is available on the subject, that, while yet there are large tracts of jungle land to break in, it will not at present pay to go to the expense necessary for Usar reclamation.

THE DIRECTOR OF AGRICULTU

Plate 41.

LTURE FOR BOMBAY AND OFFICE STAFF.

CHAPTER XIV.—NATIVE IMPLEMENTS.

Ploughs—Cinhalese—Kudávana—Hand-Plough—Konkan Plough—Negalu—Nangar—The Yoke and various Parts of a Plough—At Work—Effects—The Importance of Tilth—Iron Ploughs—Varieties—"Watt's"—"Stormont's"—"Swedish"—"Hindustan"—Working Rice Land—General Remarks on Improvement of Indian Ploughs—Action in the Soil—Other Actions causing Circulation of Soil—Introduction of Iron Ploughs into Scotland—Substitution of Wooden Mould-Boards—Reasons for Approval of Native Ploughs and Practices.

PLOUGHS.

Plates XLI. and XLII.

THIS **picture** represents, from Nos. 1 to 6, typical forms of Indian ploughs, from the smallest hand pick to the most powerful and effective implement of the sort working in India. A scale in feet has been attached to the wall, by which to judge of the size of each implement. Although these all belong to the Bombay Presidency, they may be taken as a good sample of native ploughs, which are all constructed on the same type, though they may vary in pattern in different districts.

The common Cinhalese plough is not shown, as the photographs in which it appeared were destroyed by moisture. Although the construction is on the same principle as that of the ploughs described below, it is yet very different. The pole is slender, and consists of the wood of the Kitul palm (*Caryota urens*); the body is made of a hard timber called *hampaland*, got from the buttress-like roots of a tree. The width is only about 1¼ to 1½ inches, and the greatest length 1 foot at the sole. The working part is faced with iron.

Nos. 1 and 2 show varieties of the *Kudávana* or pick, which costs from As. 3 to As. 6, and is in general use among the half-wild, nomadic hill tribes. They use it on steep places, where it would be impossible to employ an ordinary plough, while yet it is possible to grow varieties of coarse millet. One form is also used in rice-growing districts to dig up the fine soil for covering the ráb material in the preparation of rice seed-beds.

It will be noticed that the form of the pick is practically that of the plough. In some instances it is provided with a long shaft, so that all that is necessary to make it into an actual plough is to add a handle, supply a yoke, and attach a pair of diminutive bullocks.

No. 3 is a hill hand-plough, which is made to work by dragging. E. C. Ozanne describes it as the "missing link" between the plough and the pick, which he points to as being most probably the original form of cultivating implement employed by primeval man, before either the ox or the horse had been harnessed or a plough been dreamt of.

No. 4 is the Konkan small plough, which costs Rs. 3, and weighs about 20 lbs., and is drawn by one pair of bullocks, or more often, in wet districts, by buffaloes. This, or one corresponding to it, is the plough most widely known and used throughout India. It is the plough the ryot is said to pick up and carry home on his shoulder each night as his work is over for the day, to prevent it changing its owner during the night! I found a smaller, lighter, and altogether inferior variety of this plough in use on the light lands in Northern India; and yet another, which might be justly described in similar terms, in the wet cultivation, in the preparation for the rice crop in Madras. **It is quite wrong** to suppose that the universal plough of India is of an inferior description or does inferior work. The remarks explanatory of Nos. 5 and 6 will bear me out in this, but

NATIVE INDIAN PROUGHS.

even the ordinary plough represented by No. 4 is not so generally the toy-thing that it is supposed to be. In the best tracts of black cotton soil in Southern India, Madras, and Bombay, where the common cattle are stronger and better fed than usual—cotton seed, which is rich both in oil and albuminoids, being available in quantity, in addition to ordinary food stuffs—this plough assumes very useful dimensions,—dimensions that make it exceedingly inconvenient or actually impossible for the ryot to carry it on his shoulders. It is then lifted and hooked over the yoke resting on the necks of the bullocks,—the pole hanging down between them, and dragging its point on the ground. When large and heavy, it is not so easily appropriated by a covetous or unscrupulous neighbour, and may be left in the field over night. It is, however, the usual practice to remove the irons and any loose or easily detached part which is of value, and take these home for safety. It was quite a familiar sight to me, while passing through the good black soil country, to see one of the younger plough-boys perched on the back of one of his animals, with his feet dangling down by one side, while he carefully nursed his precious plough irons on the way home from the day's work.

No. 5 shows the *Negalu* or heavy plough of Dhárwár, which, depending on the character and the state of the land, is drawn by four to eight pairs of bullocks. It costs Rs. 8 to Rs. 16. The share is about 18 inches long, 3 to 4 inches broad, reaching, in some cases, 12 lbs. in weight. It is used, like the Khándesh plough, No. 6, to dislodge and bring up to the surface the trailing roots of two persistent and extremely objectionable weeds of the black cotton soil, *i.e.*, *Kunda and Hariali* (see Plates LXX. and LXXI.) It is only at intervals of a few years that thorough cleaning by this plough is practised. If land becomes wholly occupied by the strong roots of the above-named grasses, the only available ordinary method of overcoming them is trenching or picking them up with hand implements.

No. 6 is a good representation of **the Nángar** or large Khándesh plough, which costs about Rs. 5, and is drawn by one or two pairs of bullocks. It goes down from 7 to 10 inches deep. The depth is regulated by the position of the yoke, *doosar*, which is shown by No. 7 in Plate XLII.

No. 8 represents the yoke of the *Negalu*. On the road from Mahableshwar I saw one of these large ploughs drawn by five pairs of oxen do as deep and effective work as any ordinary English plough could do at home. The last two bullocks had a long yoke, which enabled them to walk clear of the line of the other cattle in front. By fixing the yoke near to the point of the pole or *halas*, the greatest depth is secured; by placing the yoke further back, the point of the pole is raised, and with it the point of the share which always keeps the same position with regard to the pole,—the depth is consequently reduced.

When the land is stiff it is usual to tie a large stone to the body of the plough, in addition to the previously explained adjustment of position, to keep the plough in the ground; or, again, when the roots of weeds give much resistance, the workman bears the most of his weight on it by resting one thigh on the handle projecting posteriorly, one toe frequently touching the unploughed land, to enable him to keep his balance and guide. When less weight is wanted, he simply presses down behind with one foot. On some of the clean, light soils in Madras, as west of Erode Junction, the handle often projects forward; this enables the man to walk much nearer his bullocks. He is not able to bear his weight on it, but that is unnecessary in clean land.

The *codia* is the arrangement for fastening the yoke to the pole seen hanging from the upper end of No. 7, or rather from a pin, *shival*, which, when the yoke is in work, points downwards to prevent the end slipping off the bullock's neck. This *codia* consists of a loop 18 inches to 2 feet long of strong 1-inch rope, threaded through two holes in a short piece of wood, hollowed on its upper side to make it fit closely to the under side of the pole, which during work is placed in the hollow part of the *codia*. **The yoke** is laid on the upper side of the pole, and is held in position by the double rope or loop of the codia passing over the top of the yoke and pressing upon it, being drawn backwards, and fastened to a rope about the strength of a "cart-rope," bound round the body, *nager*, and upright arm, *curvi*, to give the whole rigidity. The more pressure there is put upon the yoke in a forward direction the firmer does the attachment become, while the loops are quite easily loosed, if wanted, when the strain of the bullocks is removed.

The *koosa* is the strong, square iron bar or share, weighing fully 12 lbs., an inch and a quarter thick, and about 3 feet long. It lies along the upper side of the lower part of the *nager*, and is held in position by the posterior end being slightly sunk into the main body of the plough, and by the *nager-khol*, an elongated iron ring, like that at the heel of a scythe, binding it to the tapering and anterior portion of the nager.

A spud, *vilati*, is carried, and used for clearing the plough of soil that adheres to it. The shaft is used as a rod for driving the cattle. The reins, *shelda*, held in the left hand of the workman, are usually fastened to a rope, *sherda*, which passes round the forehead and behind the horns. With cattle that are unruly or difficult to hold, the reins are tied to the nose string, *nath*. A rope passing round the neck is called the *joti*.

I worked this plough for several hours on various occasions until I thoroughly understood it. I was much struck with the superior quality of work done under the circumstances, and with the wonderful suitability of its parts to Indian conditions, which, as might reasonably be expected, are quite different from those found in this country.

At Work.—The upright stilt is used as a lever to tilt the plough, and give it a different direction, by inclining the share point either in or out as required, and increasing or lessening the width of furrow accordingly. The perfect command which the cultivator has over the implement may be seen by contrasting the length of the long arm of his lever, or the upright down to the centre of the body of the plough, with the length of the short arm, or the distance from the central point to the sole.

The great length of the share and forward portion of the body of the plough acts like a long wedge, making the work more gradual and consequently easier if the length is kept within moderate limits. The arrangement also helps to keep the plough in the ground, no easy matter when attempting to go deep in damp soil.

The furrow slice cut off each time by this plough is moved, raised, and pushed aside by one-half of the body of the implement, and left at a higher level and in a looser condition than if an iron plough of modern construction had done the work. The fine tilthy powder is also preserved on the surface, or part finds its way into the gaping openings that are naturally left in ploughed land, and by closing these up reduces excessive evaporation, while yet sufficient air is present to carry on the necessary disintegration and falling asunder of soil particles.

When the furrow is being split off by one side of the body of the plough, the other side—which is of exactly the same construction, but faces in the opposite direction—gets so far under the next furrow to be turned over, breaking and losing at least a considerable part of it. When, finally, it is cut off and pushed into its place, it is in the pulverulent state already described. Thus the work of one ordinary ploughing and one or more harrowings are done thoroughly by the single operation of ploughing.

The importance of Tilth.—I believe that the retention under all circumstances of the powdery, tilthy surface is the feature of greatest importance in Indian cultivation. It is necessary here to explain that in Britain ploughing is rarely carried out when the soil is wet, because by doing so its power of growing crops is reduced. Deep ploughing is only practised with safety on rich land, and in autumn or early winter, when time is left for frost to act upon the dense and adhesive matter brought up, to break it down into a friable condition of surface.

If land of a stiff nature is ploughed with the object of immediately sowing the seed, it has to be broken by harrowing the same day, else the furrow slices get baked into a brick-like condition by drying too rapidly and too thoroughly, and do not easily pulverize; in fact, until winter comes round again it is hardly possible to reduce the surface to powder, even by the help of all available means. These remarks apply to cultivation carried out in the moderate climate of Europe, and where the land is usually left till it is sufficiently dry before it is worked. The first essential in the matter of growing all dry land cereal crops in this or in any country is a finely divided, powdery surface to form a good seed-bed. It is necessary, in the first instance, for the proper and regular germination of the seed; and, in the second place, to supply a medium in which the roots of the young plants can spread themselves and find nourishment when the store of plant food in the parent grain becomes exhausted. If the land is in hard lumps, be these large or small, the extremely tender first roots can no more penetrate them or extract food from them than from so many stones. In short, a tilthy seed-bed is the first requisite demanded by Nature. No amount of manure, no amount of after-treatment, nothing can compensate for the absence of the mechanical conditions called for to support healthy plant life in its early stages. A return of half a crop is no unusual penalty to pay for neglect of duty in this one particular.

That this is known to the native cultivator is evident from the fact, that *Indian tillage implements of all kinds are made simply for stirring the soil without turning it over.* The extraordinarily fine powder which naturally forms on the surface of soil in India,[1] if left from year to year without being turned down, has most important functions to perform in that hot climate, in addition to providing a seed-bed for the young plants. It acts as a great covering or blanket for the preservation of moisture during the hot weather. It enables the ryot to go on to his land to work without poaching or injuring it, when in a much more humid condition than would be possible under our system in this country. In India, where in most cases dry-crop land can only be worked after rain, and where it is of the utmost importance to get the crop sown immediately, the fact mentioned above comes to assume a position of vast importance. The whole work of the most important season's ploughing and planting must be done in the shortest space of time possible after it is begun. Consequently to be able to start three or four days before it would be possible to do so under other circumstances must be an advantage which will appeal to all thinking men. One example will suffice. The south-west monsoon breaks usually early in June, and in the Khándesh district the working of the land in preparation for cotton immediately begins, and is carried on during the breaks between the early rains. If the land is not ready and the crop planted by about the middle of June, it will at best only give a poor return, and might end in complete failure.

Iron Ploughs.—Many attempts have been made to introduce into India European ploughs which turn down the

[1] Specially referred to by Sir James Caird in the discussion at the London Farmers' Club on 5th December 1887.

surface soil, and which replace it with fresh soil from beneath. With few exceptions, in rare and unusual circumstances, those attempts have failed. The refusal of the ryot to adopt the new form of implement has been set down to "ignorant prejudice;" but after a careful and minute investigation of the facts and circumstances, I have come to the unqualified conclusion, that the extensive adoption of English forms of ploughs would be ruinous, and, if general, would probably reduce the crops so as to plunge the whole country into famine. If the land were turned up to the action of the sun in the wet condition in which it is now worked, or rather stirred, by native implements, it would in a few hours of hot sun bake into the condition of air-dried bricks, which it would be almost impossible to reduce. Alternate wetting and drying would accomplish it in time; but once thoroughly hard, such soil is not easily wetted, unless it is soaked or submerged in water. Rain falling upon it penetrates but a short distance. If once it assumes the baked condition it is practically impossible in the short preparation time of one season to bring it back to a state fit to grow crops. In addition to this, the land is left open to dry to a greater depth during the scorching heat of summer.

I have stated what would be the results upon land turned up wet. Looking at it from another point of view, if it were left till it became as dry as land is when ploughed in this country, even then the sun-dried, brick-like condition could not be entirely got rid of, though the hard lumps might be smaller. It is more likely that a suitably dry condition would be rarely attained during the breaks in the rains.

About Cawnpur the natives, speaking of the condition of soil suitable for their practices of working after rain, use the expression *Oat anna*, which means that the land looks dry enough for going to plough on. In Oudh they say *Mitte* (earth) *uthna* (come in season). My experience leads me to believe that land becomes *Oat anna* or *Mitte uthna* for the native plough a few days sooner after heavy rain than for the English form of plough; and if it were for no other reason than the unavoidable loss of valuable time, ploughs which turn up the soil would prove unsuccessful in India.

Varieties of Iron Ploughs.—I availed myself of the opportunity of working with my own hand all the so-called European forms of ploughs or adaptations of native ploughs which I came across, and at the same time paid particular attention to the conditions under which they were doing the work.

On the Government experimental plots at Cawnpur I saw the *Watt* American plough, now manufactured in India at a cost of Rs. 8, do very neat and clean work on dry, light soil. It had no pretensions to going deeper than the ordinary country plough, after the latter has been passed through the land a couple of times; though without carefully examining the results of the actions of the two ploughs, the former might appear to sink deeper on account of the more perfectly cut furrow and the unbroken condition of the furrow slice. Regularity in this matter under Indian conditions should not be mistaken for good quality. In principle the Watt plough is much like the native forms, but its working parts are of iron, and it has a short mould-board not present in any native implement.

At the Government Bhadgáon Farm, Khándesh, I had the *Stormont* plough tested against the *Nángar.* The Stormont plough is a small-sized iron swing plough, with short stilts, built on the English pattern. It is said to do good work in getting down under and turning up the deep roots of Kunda grass when the land is comparatively dry; but in the wet condition of the soil at the time of the trial, it had no chance with the Nángar in the matter of efficient work. The mould-board would not clean itself, and in consequence there was a tendency for the plough to come to the surface. The workman could only press down the stilts with his hands in place of throwing his weight on to help him by sitting on the handle. The work was thus made harder and more difficult, and more likely to be "scamped." It did not go so deep as the Nángar, while it cut the roots of the grass more, and did not bring them up so well to the surface. As cutting underground stems or roots simply means planting so many more weeds, this was a most serious defect. The Nángar going deeper got better under the weeds, and instead of cutting them rather tended to pull them up, and leave them to be gathered by two women following behind.

At Nagpur, in the Central Provinces, I had the large plough of that district tried against the *Swedish* plough. The native plough was inferior in make, and did not do such good work as the ploughs I examined in Khándesh. The Swedish plough is very much like the Stormont—simply a small-sized British plough without a coulter. It did decidedly better work than the Stormont plough, but under much more favourable conditions. The trial was on black cotton soil of medium quality, but it was level, and practically in the condition of garden mould, and there had been *no rain for four days*. In spite of this fact the mould-board of the Swedish plough would not clean itself, and the furrow slice was not broken as the large native plough breaks it, and no greater area was done in the same time than by the native plough, though the latter went fully deeper on an average. Some might consider the uneven and ridged surface, so to speak, of the subsoil left by the native plough a disadvantage, but as a guarantee against the formation of an impervious "plough-pan," so likely to form in certain soils when land is worked wet, it appears to be rather an advantage than otherwise. Taking everything into consideration, it is evident that, by even the greatest stretch of imagination, one could not say that the imported plough did more than approach to equality with the simple native implement under the most favourable circumstances.

In Madras the adapted plough, which seemed to have gained most favour in the official eye, much resembled the Watt plough. I think it was called the *Hindustan*, and may be seen represented in Plate XXV. working under water in preparation for a rice crop. The remarks made regarding the Watt plough are equally applicable to this one when speaking of dry-land cultivation. Its action in irrigation cultivation, in which it was said to have proved to be a wonderful success, must be dealt with separately.

I went specially to Shiyali to see a large and enterprising *zamindar*, who had 150 of the new ploughs at work on the estate he himself farmed. To fully understand the position, it is necessary to state a few general facts about this unusually large and well-managed holding. It extended to 4000 acres, half of which was worked on the old and half on the improved system. The one crop of importance was rice, and this, with the rich soil and an abundant and regular supply of irrigation water, was grown to pay. It was explained that, with a deficient or irregular supply of water, no management could make rice-growing remunerative. The work cattle had each, in addition to ordinary food, an allowance of 2 to 3 sers of ground-nut cake per day, which kept them in good condition and able to do heavier work than common, badly-fed, country cattle. I had the country plough—a very poor variety indeed, costing As. 8—tested against the new form, costing Rs. 5, and the latter certainly did more work than the common plough; nevertheless, all things considered, I could not pronounce it to be a triumph of an implement of European design over those of a good native pattern. What was wanted in this case, where the cattle were well fed and able to exert more force in pulling, was a wider implement that would do more work each time it passed through the land. The new iron-breasted plough was tried, and was found to cover a wider space, and consequently do more work, but it did so without acting as a plough at all—the mould-board never cleaned itself, but got wrapped up along with the body of the plough with an accumulation of roots and mud. It was this accumulation, which may be seen in looking closely at the plough in Plate XXV., which was doing the work of stirring up the mud underneath the water, not the plough at all in its capacity of a plough. It had been converted into a mud-collecting or retaining machine, an equivalent to which might have been made at much less cost, by fixing a few spikes into an ordinary country plough. A well-made but larger plough of native construction would undoubtedly do as good work with the same superior bullock power.

Speaking generally about the improvement of Indian ploughs, there is no hope of introducing larger or better implements into very many districts until the cattle are better fed, and consequently stronger. The comparisons drawn between the work of the so-called "improved" ploughs and the little native plough, which acts simply as a very efficient one-tined grubber, is usually unfairly stated for the native plough. It is said that one ploughing with the new implement is as good as two ploughings with the old form, but the rate at which the light, little, active cattle walk in the plough, as compared with the larger and heavier ones, alters the calculation in their favour considerably.

Again, the work of the little native plough is very much under-rated. The first time it passes over the land it may not get down more than 2 to 3 inches, but in the subsequent ploughings that are given in good practice, a sufficient depth is attained to form a proper seed-bed. This mistaken idea, no doubt, has arisen from an erroneous, though very general belief that ploughing in this country is much deeper than it really is. While ploughing for a seed-bed, a depth of from 5 to 6 inches is rarely exceeded.

Another fact makes ploughing in India look shallower than it actually is. Some of the finely divided surface-soil falls back into the furrow immediately after the plough passes, filling up the bottom of the opening, and concealing the true depth. I first assured myself of this by digging with my fingers in a furrow made by a very poor description of plough, which I examined while it was at work near to Cawnpur.

The falling into the open furrow of a portion of the surface soil each time the land is worked is a matter of great interest and importance taken in connexion with Indian cultivation generally, where there is no effort made to turn down exhausted soil or turn up fresh soil from below. The actual change in the position of soil is going on slowly, and in this there is safety. As a portion of the surface soil falls down into the furrow each time the land is ploughed, a corresponding portion of fresh soil from below is displaced, and must have started on its ascent to the surface. The great difference in the supply of fresh soil from beneath in the cases of England and India is this, that whereas the English plough turns up the fresh soil to the top by one operation from the depth of ordinary cultivation, the fresh soil in India has to go through a period of probation, so to speak, and finds its way up gradually year by year, as so much of the immediate surface gets buried. While coming up it is undergoing preparation to meet the conditions of the climate. The hard frosts of our English winters make the turning-up practice suitable and advantageous, whereas the scorching climate of India demands that fresh soil shall be brought up most cautiously.

In the black cotton soil of the Deccan, where ploughing is rarely practised, and where the horse Dutch hoe (see Plate XLIII.), universally used in place of a harrow in India, is the only cultivating implement employed, this interchange of top soil for soil from beneath goes on mainly owing to natural causes. Black soil has a wonderful power of absorbing water, and during the rainy season it swells, so that the whole surface is raised. Although it continues to retain throughout an abnormal amount of moisture, which is of great value to the crops grown on it, and, in short, enables cultivation to be practised without irrigation, at the same time, in the dry weather, it loses a large amount of moisture, and shrinks in consequence. The shrinking is in all directions; consequently very deep and wide tracks are formed, which make the land quite unsound and dangerous for riding. By the use of the Dutch hoe-harrow, the cracks are filled and closed with the fine soil of the surface, and by this means a regular circulation of soil is established. The cracks further fulfil the functions of ploughing, by admitting air freely into the body of the soil. The objects of ploughing are attained, but Nature is left to do a large share of the work, and, further, she provides the means by which man can successfully carry out the remainder of it. The plentiful supply of powdery soil is useful, not only for carrying on the circulation process, but for closing up the cracks to prevent excessive evaporation of moisture from the body of under-soil.

Introduction of Iron Ploughs into Scotland.—If more of the history of ploughs and the actual principles and practices of ploughing had been understood by those trying to introduce new ploughs into India, the "plough introduction" mania would long ago have died a natural death. It is not so long since wooden ploughs were universal in Scotland. It was some time after the beginning of this century that my grandfather[1] invented and had constructed

[1] James Wallace, Esq., of Wallace Hall, Glencairn, who died in 1824. The writer well remembers the old plough, which was, in accordance with recent experience, too short in both stilts and mould-board. It was broken up more than twenty years ago to make into shoes for the farm horses at a time when iron became suddenly dear. My friend Wm. Gray, Southfield, Duddingston, who is now in his ninetieth year, tells me that so late as 1817 some of the best farmers in the Lothians did not possess a single iron plough.

at his own foundry—probably doing a large share of the work himself — the first iron plough ever worked in Dumfriesshire, and possibly the first seen in the south-west of Scotland.

The iron plough is not without its disadvantages in some soils. In cases of certain dense clays, it has been found necessary to remove the iron mould-board, and replace it with a wooden one, to make it possible to keep the plough in the ground.[1]

Conclusion.—I have given my reasons for preferring for India ploughs of an Eastern pattern to ploughs from Europe, but I should not like to be misunderstood, and my opinion *mis*taken to be this, that the present forms and conditions of Indian ploughs are satisfactory, because I believe, with stronger and better fed cattle, the size of the plough might be increased to advantage; and further, with those more powerful cattle, in special instances where, as in Ceylon, land is first roughly broken up by the digging hoe or *mammoty*, the mould-board plough might be employed with advantage by ryots who cultivate large holdings. I saw land which had been broken roughly by the same hand implement on the Allahabad Farm, which would unquestionably have been more economically turned up by an English plough, but it had to lie fallow for a season. My remarks apply to the plough when used on land kept regularly under cultivation. Again, it must be remembered that ploughs of the same sort are like implements at home, some are more skilfully constructed than others, and do much better work in consequence. If proper means were used, it would be quite possible to extend the knowledge necessary for the construction of the best forms of native ploughs.

Not only has the native plough a peculiar and definite

[1] Fowler & Co. of Leeds tell me that in some districts in recent times the American chilled-steel mould-board, with a very finely-polished surface, has been found to do the work which formerly required the wooden mould-board.

shape for good reasons, but the practices, thought at first to be peculiar, are often well supported by successful experience. Near to Bihiya, the ryots object to plough their land after a crop is removed, and delay it until immediately before the next crop is sown, because early ploughing makes the succeeding crop too luxuriant in its early stages, and ends by giving a poorer yield of grain. It would appear that early ploughing in that hot climate hastens the decay of crop residue in the soil, and by this means supplies to the young plant the liberated nitrogenous manurial substances which should have been retained for a later stage of its growth, and the result is overfeeding followed by starving.

CHAPTER XV.—NATIVE IMPLEMENTS.

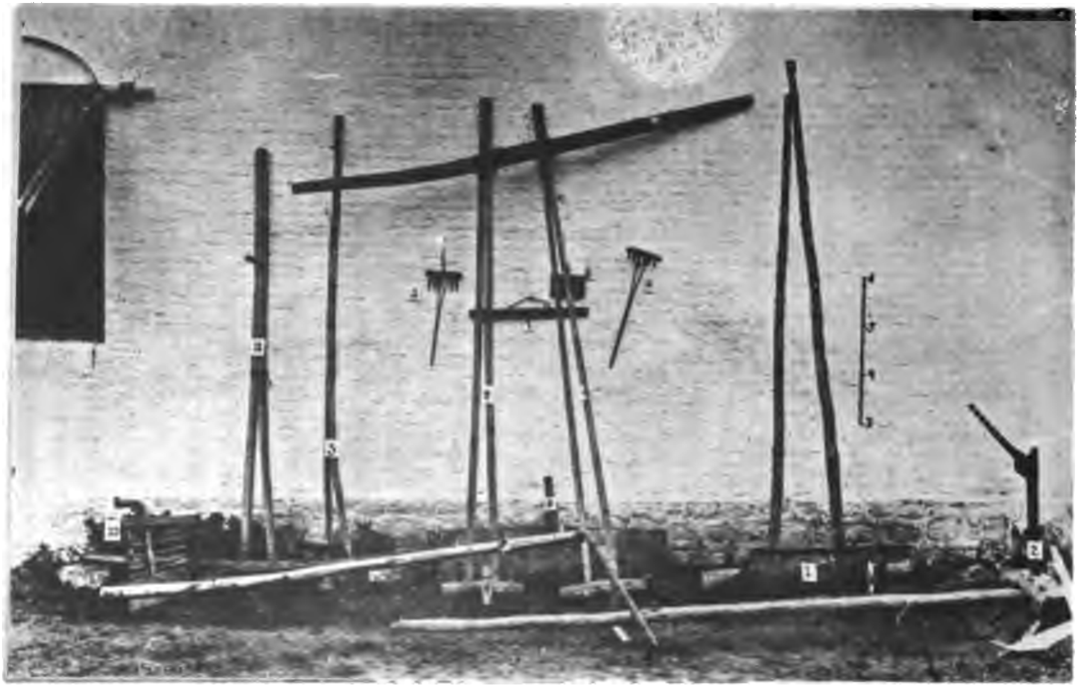
Harrows—Construction—Character of Work—Bullock Rake—Roller or Clod-crusher—Levellers—Plank Harrow—Seed Drills—Names and Construction—Method of Working—Cotton Seed Drill—Miscellaneous Tools—Sledge—Hand Rakes—Digging Hoe—Weeding Hooks—Reaping Hooks—Sundries.

HARROWS, RAKES, CLODCRUSHERS, AND SUNDRIES.

Plate XLIII.

NOS. **1, 2, 3, and 4** represent the implements in general use for performing the work done by harrows in this country. They cost from Rs. 3 to Rs. 9. They have been called harrows, but are in reality in form and action more like Dutch hoes, drawn by cattle in place of being pushed by hand. This class of implement in one or other of its forms is used to scarify the surface—(1), before sowing where ploughing is not regularly practised; and (2), after ploughing and before sowing; (3), as a seed harrow after drilling; and (4), as a hoe, to weed between the rows of growing crops. No. 1, the *áut*, is the large Deccan scarifier; No. 2, the *rámp*, is the corresponding implement used in Gujarát; No. 3, the *karabdi*, is a single drill hoe of Gujarát; and No. 4 represents a double implement of the same class.

Construction.—Of this hoe-like harrow there are great varieties in India, from those with narrow, little blades to work between rows of crops, to those requiring four to six or even more bullocks to draw them. I examined one in Madras with a wooden cross beam 9 feet long and 1 foot in diameter. The iron blade was 2½ feet long, 4½ inches



HARROWS, RAKES AND CLOD-CRUSHERS.

broad, and fully 1 inch thick at the back. This was meant to do deep work. A lighter implement with a long and narrow blade is used to cover the seed. I have measured blades 5 feet long. When the implement is not going to the required depth, the workman adds his weight to the beam by standing upon it. At times the blade and its iron or wooden supports or tines are removed from the cross beam, and this alone dragged along the surface as a pulverizer or leveller, or to cover the seed in place of a brush of thorny branches.

Character of Work.—This class of implement seems to be most peculiarly and wonderfully adapted to the conditions of soil and climate prevailing during the season when it is employed. The blade passes down under the finely divided surface soil which requires no working, and it does so in such a manner that it is in no way impeded by the presence of the surface soil, as an English harrow would be impeded in its progress. The sharp edge of the blade offers the least possible resistance to the soil; the forward inclination of it tends to keep it down into the earth, and this same inclination raises the mould cut off from the body of the soil below, dropping it behind in a loose, yet not too open condition, as the fine particles of the upper layer run into any openings, and close them to complete the operation. Land can be thus worked in a practically wet condition below, as soon as the surface tilth appears. This, if the sun shines, forms in a few hours after heavy rains; and in the black soil country, in virtue of shrinkage, the whole surface becomes a network of minute cracks, like so many veins. I saw implements of the harrow-hoe pattern working satisfactorily in Khándesh within thirty-six to forty-eight hours after 2½ inches of rain had fallen. The surface weeds were loosened, and withered rapidly in the hot sun. No other implement I have ever seen could have done work that could under the circumstances have even approached it in quality.

No. 5 shows a model of a bullock rake, *dantal*, from Kaira, in Gujarát. The implement costs Rs. 6, and is made to work across the drills of the young crops to destroy weeds. This corresponds to the East Lothian custom of cross harrowing autumn-sown wheat in spring, and to the very common and successful practice of harrowing barley after it is well up. It saves hand weeding, and encourages the growth of the crop, besides filling up cracks at the same time.

No. 6 is a model of another bullock rake, *ghánio*, from the same district. It has a long and also a short set of tines or teeth, and costs Rs. 4 to Rs. 5. It is used in rice land—the long teeth pulling up weeds, and the short ones subsequently following burying them in the soft mud.

No. 7 is the model of a roller or clodcrusher, but it is too nicely finished to properly represent the original, which is generally rounded and uneven in the upper surface. The traces of a pair of bullocks are attached to the rings, and, when necessary, the workman adds his weight by standing on the beam. It is useful as a seed coverer, as also to roll young grain crops or to level land in preparation for irrigation. The cost is from Rs. 3 to Rs. 4.

Nos. 8, 9, and 10 show forms of levellers used to smooth down and level the surfaces of rice fields after ploughing and before planting, and also for sweeping earth forward for the construction of bunds or banks. A rope is attached to each end of the board-like or platform surface, which is kept in the perpendicular position shown in Nos. 9 and 10, and retained there, while filling with earth, by the man in charge holding the handle. When the matter collected in front of the board is to be discharged, the attendant presses forward the handle, and allows the board to slip over the accumulation, either instantly or gradually, as required. No. 8 is a model of the *chen*, from Gujarát, the original of which costs Rs. 5 to Rs. 6; No. 9 represents a full-sized *ken*, from the Deccan

Plate 44.

NATIVE SEED DRILLS.

Ghats, costing Rs. 2½; and No. 10 shows the *petára*, from the latter district, and also from the Konkan. Both No. 9 and No. 10 are in position for working.

No. 11 is a full-sized *alvat* or plank harrow, also used as a light clodcrusher or leveller in both wet and dry cultivation. It is peculiar to the Konkan and to the Deccan Ghats, but is represented in Gujarát by an implement rather like it.

Seed Drills.

Plate XLIV.

Nos. 1, 2, and 3 are models one-fourth of the natural size. No. 1 is the two-coulter drill, *faidko*, of Surat—cost Rs. 3. No. 2 is the three-coulter drill, *tarfin*, of Gujarát, almost identical with the *tiphan* of the Deccan. No. 4 is a full-sized four-coulter drill, *kurigi*, from the Bombay Karnátak, identical with No. 3, called *chavár* in Gujarát, and *pábhar* in the Deccan. The cost is about Rs. 3 to Rs. 8. These drills are all on one general plan, and all drawn by one pair of bullocks. The coulters are of wood, with iron points, and placed about a foot, more or less, apart. The hollow bamboo tubes, which rest on and communicate with holes through the coulters, are united to the base of a cup made of soft wood, such as mango, and with a hole opening into each bamboo. The parts are tied together, as shown in Plate XLIV., to give rigidity. While sowing is going on (in most crops except cotton), the bulk of seed is suspended in a cloth like an open apron, which has one end tied to the handle seen in the left hand of the man to the right in Plate XLIV., the other end being fixed under the cup at Figure 5. The seed is removed by the left hand of the sower, and as the drill moves on is gradually dropped from the heel of the hand into the cup. It there separates itself into the various tubes, and finds free vent to the ruts made by the coulters. There is a heavy variety of this drill, weighing

200 lbs., used for sowing cold weather crops, like wheat and gram, that require to be deposited deeper than the so-called early rain crops.

No. 5 shows the *cotton kurigi*, or wide two-coulter drill, costing Rs. 4. It is used for sowing other crops than cotton, and is in consequence identical in construction with No. 1. When cotton is sown it is dropped through two bamboo tubes, kept in their upright position by two women. The tubes are also attached by thin ropes to the beam of the drill (see Plate XLIV.), and drawn along with the lower ends opening into the newly made ruts. These drilling machines have been in use from time immemorial, and when skilfully handled, which is very frequently the case, they do beautiful work, leaving nothing further to be desired.

MISCELLANEOUS.—HAND TOOLS.

Plate XLV.

No. 1 shows a sledge, *ghase* or *khirle*, for carrying the bundles of rice seedlings, as seen in Plate XXV., from the seed-bed to the field into which they are to be transplanted. Its joints are made very loose, so that when loaded it yields in an extraordinary manner, accommodating itself to most irregular surfaces met with going cross-country, so as to retain its burden on the way to the field. It is used on the Deccan Ghats, and costs Rs. 2.

No. 2 is a six-toothed hand rake, *panjeti*, extensively used throughout Bombay Presidency for spreading manure, or for raking together the corn on the threshing floor.

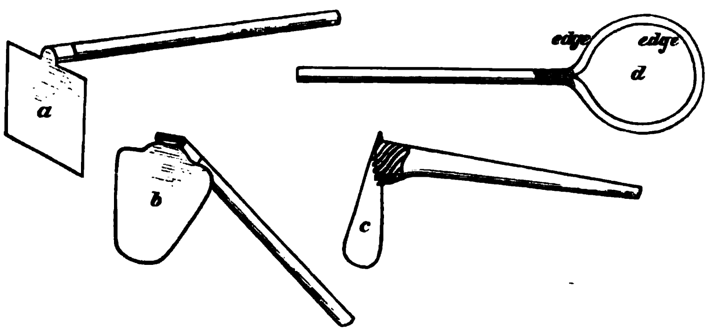
No. 3 is a long-shafted hand rake, *dátále*, used to level seed-beds after ploughing, without necessitating the treading of them by the feet.

No. 4 is a digging hoe, *khodáli* (Northern India), *pávado* (Gujarát), *mammoty* (Ceylon). Though varying considerably in form in different parts (see *a*, *b*, and *c* in the accompanying Fig.), it is universally used all over India in place

Plate 45.

MISCELLANEOUS IMPLEMENTS AND HAND TOOLS.

of the spade. Natives take kindly to working with this implement, and excel at it much in the same way that an Irishman excels in working with the spade. It costs As. 8 to Rs. 1. A native does not care to work with a spade, and when a spade is adopted two men are told off to it—one holding the handle and the other doing the greater part of the lifting, by means of a rope tied round the neck or where the handle and "mouth" or blade join.



Native Hand Hoes.

A digging implement like No. 4 is most extensively employed in field cultivation in Italy. A primitive form of it—Fig. *c*—is seen in the Andaman Islands. A shell is used in place of an iron blade, and it is fastened to the handle by cane. Watt says that he found the same implement in use on the Naga Hills, only iron or stone formed the blade, which was not more than 4 to 6 inches long and 2 inches broad, and was tied to a wooden handle, or more frequently to the root end of a bamboo. Watt found a still more unique hand hoe in this same region. See Fig. *d*. It consisted of a hoop of metal fastened to a wooden shaft. Both edges are sharp, and it is dashed through the ground, cutting the roots almost without disturbing the surface soil.

No. 5 shows two varieties of weeding hooks, called *khurpi* in the Deccan; *karapdi* in Gujarát; *kurchagi* in the Karnátak. They cost from 1 anna to 4 annas according to size. Both the outer and inner edge of the blade is used for digging up weeds which spring between the rows of crops when these cannot be got at with the bullock hoe.

No. 6 is a group of reaping hooks of various sizes and shapes from various parts. They cost from Rs. 1 down to As. 4. In the Deccan and Konkan this hook is called *vila*. Rice is usually cut with a saw-edged hook, and the larger millets with a plain-edged one.

No. 7 shows a bill hook—*koyta* in the Deccan and Konkan, and *kandali* in the Karnátak. It is used for lopping wood and in the repair of field implements.

No. 8 shows forms of a hook—*halikoyyavakudagulu*, sometimes with a serrated and sometimes a plain edge, costing from Rs. 4 to 10. It is for trimming the banks or the edges of rice fields.

No. 9 marks two carrying poles, *baila*, used for carrying bundles of wood or grass up to 150 lbs. On the platform on which the weight rests is a pad made to rest on the head. Cost As. 8 to As. 12.

No. 10 is the *pendse*, a sort of combined beater and shovel, employed in making or mending the banks round rice fields. Made by the cultivator at a cost of one anna to half an anna.

No. 11 shows a full-sized dibble, *rambho*, used for planting hedges in Gujarát.

No. 12 is a garden hoe from Bassein.

CHAPTER XVI.—IRRIGATION.

Importance of—Area Irrigated—Sources of Water Supply—Excellence of Native Water-lifts—The Persian Wheel—The Mohte or Bag—The Double Mohte—Dhekudis and Budkis—Counterpoise Lift—The Picota—Tripod Scoop-lift.

IT may be safely asserted that but for irrigation, India could not support her teeming millions, yet when we think of the extremely small portion of the total cultivated surface which is irrigated, and consider it merely from the point of view of area, irrigation is apt to assume insignificant proportions. **Recent statistical returns** show the total cultivated area of British India, including Lower Burma and Mysore, to be somewhat below 200,000,000 acres. In 1886 the land returned as irrigated amounted to only 30,000,000 acres, and more recent statistics make it considerably less. It must be remembered that much of the irrigated land consists of the richest and most productive soil in the country,—the low-lying places on which for generations the washings from the higher levels have accumulated,—and that where irrigation is properly carried out the serious losses resulting from climatic influences are averted. A minor consideration, but, from a practical point of view, also one of considerable importance, is the spreading of the labour connected with field operations more equally throughout the year. When all those points are remembered, irrigation assumes the degree of importance which it really possesses.

The water supply is usually classed as being derived from three sources, named in order of importance, judging from the areas influenced by them,—(1) **wells**, (2) **canals**,

(3) **other sources**, which include tanks, lakes, and rivers. The total irrigated areas by no means remain constant, nor yet in many instances is the same land irrigated each year. It may be broadly stated of the two most important sources of water supply, that the land irrigated from wells is double that irrigated from canals.

The following quotation from the *Statistical Atlas of India*, 1886, will indicate the localities in Northern India where the different methods of irrigation are found suitable. The remarks refer to the great Gangetic plain which extends from Calcutta to Peshawar: "The soil of this field gradually changes from sand in Rajputana and the Punjab to loam in the North-West Provinces, and to clay and mud in Bengal. It is canal watered in the west" (where the subsoil water is too deep to be easily reached from the surface), "honey-combed with wells in the centre, and washed in the east by rivers and Nile-like floods of fertilizing mud and water." **The black soil tracts** of the central plateau of the Indian continent are least irrigated and least suited to irrigation, tending, when abundantly supplied with water, to become water-logged, but they require it the least on account of their great power of retaining the natural moisture.

In connexion with well irrigation there are various native methods, which, for suitability to the conditions, for cheapness, simplicity, and efficiency, cannot be equalled, far less surpassed, by any mechanical contrivance from the European world. Perhaps the two most serviceable methods adopted where water is lifted in quantity are—(1) *the Persian wheel* for depths not exceeding 50 feet, and (2) *the bag or mohte* for greater depths.

The Persian wheel (though, strange to say, it is not the means commonly adopted for lifting water in Persia) may be seen in Egypt; but it should be understood that, in the matter of its agriculture, Egypt possesses a great many points in common with India. Plate XLI. shows two models of the Persian wheel, which is driven by one or more bullocks or buffaloes yoked in a very homely and simple fashion, involving the principle adopted in the ordinary horse threshing-mill. The water is lifted in a series of earthenware pots, which are lashed to an endless rope-ladder-like arrangement, consisting of some sort of strong fibre, and passing over a revolving cylinder or drum which carries it round. The water gets discharged as the pots are one by one inverted at the top, and is made to fall into a shoot, which forms the beginning of the water-carrying channels. The cattle, I was informed, are always made to move round in one direction, viz., from right to left, and they are usually blindfolded to keep them from getting giddy, the circle round which they move being small. They are generally shaded from the sun by a roof-covering. This is most necessary in the case of buffaloes.

The bag or mohte (kavaly in Madras) is usually made of leather, though sometimes it takes the form of an iron pot. When elephants were more plentiful, the tongue or spout of the bag consisted of the tanned skin of an elephant's trunk; now, owing to the difficulty of getting any material to stand the wear, the spout is the weak point which costs most to keep in repair.

Plate XXXV. shows two buffaloes which I saw doing work at the well, the water-bag and head-fittings of which appear behind them. In pulling up the water by means of a rope passing over a single fixed pulley at the well head, the draft animals are made to walk down an inclined plane as long as the well is deep, and often artificially formed by a hole dug in the level surface. The ropes are in the position which they naturally occupy when the animals are at their full distance down the incline; but I had the latter brought up, so that, if possible, the bag in the position of discharging might be seen along with the beasts.

In the double mohte, which is a European invention, the bullock is yoked as in the Persian wheel, but made to turn round and go in the opposite direction each time a bag comes up. The original, higher cost of construction is the usual defect of the European suggestions as to improvements on native systems of water-lifts. The lifts called *dhekudis* on the rivers in Gujarát and *budkis* on smaller streams in the Deccan, are simply adaptations of the bag-lift. In a rapid-flowing river, mooring a boat fitted with paddle-wheels, which are carried round by the rush of water, is a cheap and ready method of securing water-lifting power.

The ordinary lever or counterpoise lift, shown in Plate XLVI. (*b*), is perhaps the most world-wide means of water-raising that could be named. It is common to India, Europe, and America. It is to be seen in the United Kingdom, and even as far north as Norway. The construction is most simple: a lever beam is supported by its middle on a fixed, upright pole; one end of the lever is permanently weighted, and this weight is made to balance the bulk of the water which is brought up in a vessel suspended from the other end of the beam.

The picota water-lift of Madras (Plate XLVII.) is constructed on the lever principle, but in place of a dead weight, one or two men moving backwards and forwards on the horizontal beam throw their weight, as it were, into the scales, so that the iron bucket filled with water is raised to the surface, where it is emptied, and returned by a man who stands at the mouth of the well. This work is attended with no little danger, unless there is a resting platform for the men to get on to, or something more than a bamboo to hold by, as the men at work are at a considerable elevation from the ground. It is said by natives that the picota is twice as bad as the killing god, because he only kills one man at a time, but the picota often kills two!

A small scoop-lift, suspended on a tripod, is shown in Plate XLVI. (*a*). The scoop is swung by hand, and made to lift water in a very simple and ingenious way, but only from the depth of 3 feet.

(*a*) **WATERLIFTS.** (*b*)

Plate 47.

PICOTA WATERLIFT

CHAPTER XVII.—ROTATIONS AND MIXED CROPS.

Rotation of Crops Understood—Kharif—Rabi—Catch Crops—Mixed Crops —Advantages—Examples of Rotation.

IT is quite a mistake to suppose that the native cultivators of India are unacquainted with systems oi rotation of crops. It is a fact that an extraordinary variety of rotations is practised in India. There, systems are much more varied and numerous than in England. This may be accounted for by the great variety of soil and climate, and the vast numbers of species and varieties of crops under cultivation.

In these circumstances, planting and harvesting go on more or less at nearly every season of the year, nevertheless there are certain classifications of crops that call for explanation.

Kharif, early or summer crops, are those sown with the fall of the south-west monsoon rains in June. They are also called rain crops, and are generally harvested in autumn; but some kharif crops, such as sugar-cane, occupying the ground ten months, are not harvested at the regular kharif season. In Bombay these are usually classed as *dufasli*, or two-season crops.

Rabi, late or winter crops, are those put into the ground after the arrival of the north-east monsoon rains in September. They depend largely on the dews of the cold season for necessary moisture.

Catch crops are taken on some kharif or light land before the regular rains begin, and also on rabi or heavy moisture-retaining land, when the season permits, before the sowing of the ordinary late crop. The last returns, which exclude Bengal and Ajmere,[1] show that about 11·5 million acres, or approximately $\frac{1}{11}$ of the cultivated area, grows more than one crop in a season. In the densely populated regions, as Oudh and the North-West Provinces, the proportion rises to about $\frac{1}{4}$ and $\frac{1}{6}$ respectively. In Bombay they are styled *dusota*, or second crops.

The growth of mixed crops is a wide-spread practice which is well worth consideration and study. The system is more or less known in this country, though not extensively followed. The advantages under Indian conditions are distinctly great. Two properly assorted crop plants of different species grown together on the same area give a larger total yield than either crop grown singly, because their roots possess different habits of growth and different functional powers, and do not much interfere with the action of one another. Apart from this, there is safety in sowing various kinds of plants together, so that as the season proves to be too wet or too dry for certain crops, there may be in either case a sufficient number of plants left suitable to the surrounding conditions. By this means, in a wet year, the mixed crops finally consist largely of water-loving plants; those with a drier habit of growth having been checked and cramped at an early stage. In a dry season, on the other hand, the dry land crops predominate.

I am inclined, also, to think that there may be decaying roots or matters thrown off by plants of distinct species, which matters, in the hot climate, become available within

[1] In the *Statistical Atlas*, 1886, Ajmere, with nearly two millions of acres under crop, is returned as growing no catch crops; Bengal, with a crop area of 54·5 million acres, is also entered as having no double cropped land. If this is absolutely correct, it will materially reduce the above proportion of $\frac{1}{11}$ of catch crops in speaking of the whole empire.

the period of the growth of a given mixed crop; and, in the case of a grain crop grown along with a mixture of pulse, we may have more or less of a beneficial action, such as that of the well-known influence of clover root upon a succeeding wheat crop. Some of the minor ingredients of the mixture often remain on the ground long after the principal crop has been harvested. The advantage of this is the covering of the surface and the preservation, for the use of succeeding crops, of the nitric acid liberated by the natural process of nitrification.

Mixed crops are planted in several ways—(*a*) the seeds are mixed before sowing, so that the mixture is complete; and (*b*) two or more crops are sown in alternating rows, each row being devoted to a particular species of plant in the mixture.

In good garden cultivation, which is to be found in many parts of India where there is access to a good market, the practice of mixing crops is carried out to perfection, and usually with a command of water which eliminates the disadvantages referred to climatic influence. At Lahore, in one small irrigation bed of about 8′ × 6′, I found growing, in one group as it were, melons, juári, onions, sweet potatoes, and a gourd. In the Southern Maratha country I found sava millet and kulthi, or Madras horse gram, growing in a mixture. Every seventh row consisted of kulthi.

At Cawnpur a common mixed crop occupying one year in the rotation consists of hemp, juári, till, and urher, sown together in Kharif, but reaped at different times as they become ripe in the order named. This, no doubt, is one of the reasons why mixed crops are so successfully grown in India. Hemp is usually sown on the borders, but the other seeds are mixed and broad-casted. Urher, though sown in Kharif in June after the first rains, is reaped with the rabi crop in the following May. After it the land is left fallow, and should be ploughed ten or twelve times from the end of the Kharif work—say August till the end of October—

and wheat sown in November. Barley may be sown in place of wheat in weak land, and in that case it receives only four ploughings. The mixed crop may continue to alternate with wheat, or the latter may be followed by indigo. The few foregoing illustrations, and the references made to mixed crops in the descriptions of the food plants, will suffice to show the nature of the mixed crops of India. The subjoined examples of rotations will do the same for Indian systems of rotation.

In the Punjab, wheat is at times followed by bájra on unirrigated land—sown in July, and cut in October and November. In Northern India, sugar is often succeeded by indigo, and in some places *Faseolus mungo*. In the neighbourhood of Cawnpur one three-course rotation consists of—(1), indigo; (2), wheat; and (3), pulse. Out in some country parts—(1), sugar (heavily manured); (2), wheat; (3), pulse. In the vicinity of Saharanpur and Meerut, in market garden cultivation—(1), maize; (2), potatoes; and (3), tobacco, are grown in succession.

At Kelvi Mahim, in the very excellent garden cultivation there practised, I found one rotation frequently followed—(1), plantain; (2), ráb; (3), ginger; (4), sugar-cane. In some instances the rotation extended over seven years, and *Betel vine* was made to follow plantain.

The few foregoing illustrations of mixed crops and of rotations are not intended to be at all exhaustive, but only to convey an idea of practices which abound with variety in India.

There is but one explanation of the existence of these practices, viz., that they have been found advantageous after long experience and much careful consideration on the part of a body of workers who, for power of observation and an intelligent interest in and knowledge of every-day occurrences, would put to shame those classes which hold a corresponding position in educated Europe. Had they been left entirely to their own devices to grow their crops in their own way, to supply their own wants and nothing more, roughly speaking, it may be said they little required European advice or interference; but now that we have disfigured the natural face of the country by a network of railways, which offer inducements to recklessly throw away time-honoured practices without a sufficient experience of what is being substituted for them, it is, for this reason alone, our duty, as the rulers and protectors of an unsophisticated people, to guide them by science in those new ventures of which it is acknowledged they have not experience.

CHAPTER XVIII.—CROPS.

Books of Reference — Summary of Food Crops: (*a*) Rice, (*b*) Millets, (*c*) Wheat, (*d*) Barley, (*e*) Sugar—Maize—Potatoes—Tea and Coffee—Paddy or Rice—Varieties—Bengal Names—Planting—Preparing and Levelling Soil — Rice Cultivation — Shiyali — Transplanting — Ráb — Materials used—Limits—Effects—Advantages of a Seed-bed—Valueless Character of Dung—Kumri or Juming.

CROPS **of all kinds** have been fully dealt with in annual reports of Indian officials, in Duthie and Fuller's *Field and Garden Crops, etc.*, in Church's *Food Grains of India*, and in the *Statistical Atlas* and *Catalogue of Exhibits* published in connexion with the Colonial and Indian Exhibition, London, in 1886. It is unnecessary for me to do more than draw attention to a few of the important points connected with the growth and uses of a limited number of the crops which are least known in this country, and which occupy positions of importance in supplying food for local consumption and for exportation, or as producing raw materials for various industries. When arranging the following remarks, I found the above books most valuable for purposes of reference.

FOOD CROPS CONSUMED IN DIFFERENT PARTS.

Rice has often very erroneously been considered the almost universal food crop of the native inhabitants of India. It forms a portion of the diet of the wealthier classes in all parts of the country, but it is the staple food of but a limited section of the population—those

Plate 48.

ZEA MAYS, L.
(*Maize*)

found in the neighbourhood of the areas suitable for rice cultivation.[1]

The most important and most widely used food grains of India are **millets**, of which three conspicuous species—*juár*, *bájra*, and *ragi*—are shown on Plates L., LI., and LII. In well-balanced diets, **pulses**, in varying proportions and of various kinds, such as *gram*, *peas*, and *lentils*, are associated with the millets.

Wheat is consumed by the wealthier classes in most parts of India, but only in the Punjab does it assume the important position of being the staple food of all classes.

Barley enters into the food supply of some of the northern regions, and is grown to some extent for exportation. The most recent available returns show an area of 5½ million acres under barley.

Sugar must also be named as an important ingredient of human food. It is extensively consumed as green cane, or in sweetmeats, after it has been refined from either of the two great sources—the expressed juice of the sugar-cane, *Saccharum officinarum*, or from the sap of the common Indian date palm and other palms.

Maize or Indian corn, *Zea Mays* (Plate XLVIII.), is pretty widely used while the cobs are in the green soft state. This is an illustration of a crop which is foreign to the country being extensively adopted within comparatively recent years.

It is often sown as a catch crop before the rabi crop of wheat or barley. It was common to witness little patches of it growing in great perfection in the richer hollows in the neighbourhood of Dárjíling, as well as in areas of wider extent in the plains. "Along with amarantas it may now be considered the chief food of hill people of the N.-W. Himalaya. The full-grown cobs on the house-tops ex-

[1] The Colonial Exhibition Catalogue says, page 85, "In Bengal, Burma, Orissa, the eastern portion of Central India, Southern Madras, and Western Bombay, rice is the principal food."

posed to ripen is a striking autumn feature of village life near Simla. The ripe grain is there reduced to flour."—*Watt.*

THE POTATO,[1]

Solanum tuberosum.

The potato is now grown all over the empire. The quality is not good in the matter of colour or texture, being in most districts deep yellow and often waxy, as if the tubers had been grown in an excess of potash salts. The influence of the climate no doubt has to do with the defective characters, but, in addition, the natives in some parts encourage this inferiority or degeneracy by selecting and growing from "sets" of a waxy texture.

In accordance with certain peculiarities in the native character, they adopt an English practice or custom, but pervert it at the same time so as to have about it something exclusively and peculiarly native. In the case in point the peculiarity is that they make potatoes into sweetmeats by boiling them in sugar, and, as they find that small inferior waxy ones absorb more sugar, they select seed which will produce the article in demand.

TEA AND COFFEE.

Tea, *Thea*, is rapidly becoming a favourite beverage of the native population, especially among the higher castes, and I believe it will one day be universally drunk in India. Dárjíling and Assam were the centres that first became famous for tea planting, but tea is now largely and successfully grown in the Tari, at the lower reaches of the hills on the way up to Dárjiling, and also on the Ghats and the Nilgiri Hills in Southern India, and I may add in Ceylon. In the latter instance tea is gradually assuming the position of

[1] The remarks upon the potato, tea, and a few of those under wheat, and the silver question, were first made by me in a lecture to the London Farmers' Club on 5th December 1887.

importance which coffee occupied before it was destroyed by the blight, *Hemileia vastatrix*, and I am told Ceylon is recovering from the losses which followed as a result of the failure of the growth of coffee. Money is not now made so quickly, and many planters have been ruined and have disappeared, but trade is being established on a more substantial basis. Tea is not altogether free from disease or enemies. The most serious blights, which, however, are not general, are caused by minute red spiders in hot, dry weather, and by green flies in cold, damp weather. The injuries are always greatest where the tea plants are not growing luxuriantly, either from the soil and climate not being naturally altogether suited to their most vigorous growth, or from the exhaustion of soil due to long cultivation, or washing by rain where gardens are situated on steep hillsides.

Coffee, *Coffæa*, although almost extinct in Ceylon, is now being successfully grown on the Nilgiri Hills. The coffee shrub is more delicate than the tea shrub in this, that it cannot like tea withstand the frosts which are experienced at the higher elevations, and, consequently, in going up to a hill station like Utakamand one passes through the coffee growing belt into a tea-growing region above. The coffee blight is known in these parts, but the conditions are such, for the present at least, that it does not make much headway.

RICE, *Oryza sativa*, L.

Plate XLIX.

Paddy is perhaps the more correct common name for the crop, while that of *rice* might be appropriately confined to the grain.

This crop is represented by a greater number of varieties than any other crop in India. The number considerably exceeds 5000 (Watt), and the habits of growth, colour, and general appearance differ in a most extraordinary fashion. From dwarfed specimens, which grow almost as dry land crops, and reach only 2 feet high at full growth, there are all conceivable stages up to giant varieties, which extend to 12 feet in height under ordinary circumstances, and up even to 20 feet in special cases of unusually high floods.

Paddy is essentially an aquatic plant, growing in what proves to be an excess of water for most other crops, and consequently it is, as a rule, planted alone. Though fond of water, most varieties of paddy are destroyed in a very few days if totally submerged, but this rarely occurs, as the plant has an extraordinary power of rapid growth should the water suddenly rise about it.

Bengal being the most important rice-growing region, I have adopted the names there used for the three important crops grown at different seasons in that region, as applying to crops which may be considered typical of Indian paddy cultivation generally. *1st, The Aus*, early or autumn rice, usually sown broadcast in April or May, and harvested in July and August. It is grown in the rainy season without being inundated. *2nd, The Áman*, late or cold weather rice, requires to be well supplied with water. The best varieties are harvested in October and November. The coarser kinds, grown in deep water, are cut later—during December and January. The áman is the most important rice crop, supplying fine, long, white samples for exportation, as well as short, thick, and red or dark samples for local use. *3rd, The Boro*, or poor man's crop, of inferior quality, is sown or planted from December to February, and harvested during April or May. With the varying climate and conditions of India, rice is being planted and harvested in some parts at all seasons of the year.

Planting the Crop.—It has been shown that of the two methods of planting—(1), by drilling or broadcasting the dry corn on the land where the crop is to grow; and (2), by sowing, in the first instance, on a well-prepared and rich seed-bed or nursery, the latter, though costly as regards labour, gives a much more remunerative return than

ORYZA SATIVA, L.
(Rice or Paddy)

the former. The yield of grain per acre in the case of the transplanted crop is said to be, under a fair trial, 16 maunds against 10 or 12 maunds in the other instance.

In preparing land for what may be termed the **dry land rice cultivation,** the field has first to be banked or "bunded" with earth walls, to prevent the rain-water running off, and taking with it the valuable nitrogenous compounds brought down from the air, and also some of the finely-divided solid matter of the soil, as well as washings of a soluble nature from the surface. Much of the land growing rice in regions with irregular surfaces has been collected in the lower levels by banks thrown across muddy streams to stop and accumulate the sediment. Water, apart from the valuable substances held in solution or suspension, is of primary importance, by softening the land to admit of the cultivating implements doing their work, and also by enabling the water-loving plant to thrive. The crop is put in when the land has been ploughed several times and properly levelled.

Levelling seems to be a most essential operation in all kinds of rice cultivation. Even on the steepest hill-sides, the soil is thrown into terraces[1] and levelled with the most admirable skill, not only for the purpose in this case of having a proper seed-bed, but also that the water-supply, which is frequently limited, may be regularly distributed. A level surface secures an even distribution of water to *all* parts of the field, which tends towards uniformity in the quantity and equality in the ripening of the crop.

When the rice is sown dry, it is a common practice, followed by good results, to plough the field again after the plants are about 3 or 4 inches up, so as to keep the soil from becoming too dense. The form of the native plough is precisely what is required to do the work

[1] Terracing is, of course, adopted on steep places in the case of all crops.

without causing the injury to the crop which would follow if buried with a plough of English construction.

The superior style of rice cultivation was seen by me at Shiyali on 9th August, where the crop was in the process of being planted, as may be seen by an inspection of Plate XXV. In this locality the soil is good, and there is an abundant supply of water. The practice followed may be considered typical of rice cultivation under similar circumstances in other parts, although in minor matters of detail practices in different districts vary considerably. The seed-bed is prepared with great care, heavily manured, and well worked under water to destroy the weeds and to secure a perfectly level surface of mud, on which to broadcast the seed after the water has been let off. The irrigation being under command, the water supply is regulated to a nicety.

Transplanting.—Forty days after sowing, when the plants are about one foot long, they are pulled by men who, using both hands, uproot with each hand alternately two or three plants at a time. The plants are retained until the hands are full, and all the while, during the intervals between the moments of pulling, the roots are well shaken in the water which is allowed to stand on the seed-bed to make the work easier. Each handful or bunch is then freed of all the mud and moisture that will shake off by striking against a stick of perhaps an inch thick, kept standing in the ground within easy reach of the puller. The two handfuls are thereafter tied into one bundle by twisting a few tops of the paddy seedlings into a loose temporary rope and passing this round the bulk, a few more plants being taken in to add to the length of the band when it has passed fully half-way round. The end is fastened by being tucked underneath the band, and the bundles are ready to be carted or otherwise conveyed to the planters, to be set out the same day if possible. In some parts seedlings are kept sometimes for a week before they are planted out, but this must weaken them and retard their future growth. In Plate XXV. two bands of women may be seen at work planting by hand into the soft mud the young seedlings, in small bunches of three or four together, at intervals of 6 or 8 inches. The number varies according to the size and quality of the plants. The whole surface remains submerged under a few inches of water while the ploughing is going on. Six women plant an acre per day when the bundles of seedlings are brought to them by a man, as shown in Plate XXV. The levelling implements are not used in this part, but lumps that stand up above water are broken down with the common spade-headed hand-hoe of the country.

It has long been a matter of surprise that paddy should have grown year after year on the same soil for generations without the land being manured. This seems to be accounted for by the following facts:—(1), That rice is "notoriously deficient" in mineral matter and nitrogen, or, in other words, the substances which ordinary crops take away from the soil; and (2), being grown on the lower levels, and on land which is flooded by water from higher ground, any little exhaustion of soil seems to be made up by what the water brings with it.

Statistical returns are not now regularly made for Bengal, but, according to the last available figures, 37½ millions of acres were there under rice, and this, added to the total rice area of 22½ million acres returned in 1887 from all other parts of India (excepting Ajmere), gives an approximate grand total of 60 millions of acres. The figures are meant to show the importance of Bengal as a rice-growing region as compared with all other provinces of India. The other areas in order of importance are,—Madras, with (in round numbers) 6 million acres; the N.-W. Provinces, 4 million acres; Lower Burma, 3¾ million acres; the Central Provinces, 3 million acres; and Oudh, 2 million acres. Rice is subject to an export duty of nearly 15 per cent., which has no doubt curtailed the trade with Europe. The amount of exported rice not in the husk was almost 27 million cwts. by the returns of 1887, an increase in volume of 15 per cent. in fifteen years, but a decrease of 4 million cwts. within the last five years.

RÁB.

The word Ráb literally means cultivation, but in its restricted and common meaning it denotes the growing of the young plants—principally of rice, but also of Ragí (*Eleusine coracana*), and Varai (*Panicum miliaceum*)—on seed-beds which, as a part of their preparation, have burnt on them dung or certain herbaceous substances to be hereafter described. Ráb may also signify the material burnt.

The details of the subject are so exhaustively treated in the two admirable reports of the Director of Agriculture for Bombay—(1), "Ráb Experiments, 1884-85," and (2), "Rice Cultivation in Thana," dated 1886—that I shall merely mention the leading points, without attempting to add anything of importance to the information there given, with the object of preparing the way for my explanation of the merits of the practice, which I claim to be original, and for which I accept all responsibility. I may be allowed to add that, as this subject was being vigorously discussed when I arrived in India, I paid special attention to it, and had ample opportunity of thoroughly investigating the process in all its details as it is carried out by the native population.

The site selected for the seed-bed is usually on land more or less elevated, to overcome waterlogging and consequent destruction of the young plant. It is banked or "bunded" to prevent surface washing, and to retain the necessary amount of moisture. The burning is done in the dry weather before the advent of the south-west monsoon.

The materials used are:—

(1.) Cow dung, collected in the dry weather, and preserved in the form of cakes, or, in rare instances, smeared on to the ground while wet.

(2.) The loppings from trees or brushwood cut green, when the leaves are about full grown. The Ain, *Terminalia tomentosa*, is the tree most appreciated by the natives for the purpose.

(3.) Dead leaves.

(4.) Grass, usually coarse and rank.

(5.) Inferior straw, after it has been beaten down by the tread of bullocks on the threshing floor, or husks.

(6.) Pit manure, or dung, collected during the wet season, along with ashes and village refuse.

(7.) Earth in a pulverulent condition.

When dung is plentiful it may be used alone, spread carefully over the surface in a thin layer between one and two inches thick, or the other materials may be used in place of dung; but the most serviceable common methods adopt a combination of substances,—(1.) Dung broken into small pieces from the cake condition, and evenly distributed; (2.) A layer of leaves or loppings, also carefully reduced to uniformity by chopping where necessary; (3.) Grass; (4.) Finely-divided straw, to close the openings between the stems of the coarse grass, and prevent (5.) the earth, which forms the fifth and final layer, from falling through. The function of the earth, which is often mixed with an equal amount of pit manure, is to keep the materials together and exclude air, so that the burning may be prolonged. This is also induced by firing the layer on the lee side, so that it burns against the wind. To make the conditions necessary for smother burning more perfect, the surface is not disturbed before the ráb is deposited, at least in the case of heavy soils that do not readily break down under the influence of the sun; where the land is light, it is sometimes ploughed and levelled before being rábed.

The limits of Ráb.—Thana seems to be the stronghold of this system of cultivation—over 81 per cent. of the total area cropped requiring ráb in the preparation of the seed-beds.

From the Konkan—the low-lying land, principally under rice, extending along the western seaboard of India north and south of Bombay, and in which Thana is situated—ráb cultivation stretches over the ridge of the Western Ghats, and may be seen at Poona. It is essentially confined to districts of very heavy rainfall; not only so, but to districts noted for the "intensity and continuity of the early monsoon."[1]

The effects of Ráb are:—

(1.) The change of the dung and other organic or herbaceous substances by burning into a useful form as regards the ash for the support of the young plants. The nitrogen is given off into the air.

(2.) The destruction of the roots and also the seeds of weeds lying near to the surface.

(3.) The action of the heat on the surface soil tends to make it more open, and to liberate potash and phosphoric acid from the soil substance, in the same way as clay-burning acts at home.

The heat is moderate, though at the same time considerable. On scraping down with a knife, through the surface of a *pucca* (good) seed nursery, I found immediately after the fire had passed that the soil was so hot half an inch down that I could not comfortably hold my finger on it.

The great advantages of a seed-bed are that the young plants early acquire a habit of vigorous growth, and can be brought forward on well-tended, restricted patches of land, while the larger areas are being suitably cultivated in preparation for them. The best part of the season is thus

[1] E. C. Ozanne says:—"I believe that the rainfall is as heavy, perhaps heavier, in places where ráb is not known—British Burma, for instance. The total fall is therefore not the only factor. I believe that the distribution of the rainfall is nearly as important."

secured for the crop to grow in. The finer and more valuable, and at the same time more tender, varieties of rice pass the uncertain or risky stage of their existence in a place where care can be bestowed upon them.

As already stated in the case of rice cultivation in Madras, seed-beds are prepared and grown from in other parts of the country and the advantages reaped without the use of ráb; but everything seems to point to the impossibility of ráb being dispensed with in certain rainy regions.

By referring to my remarks on the decay of dung when kept in an extremely wet condition, I believe a full explanation may be found of the importance, I should say almost the necessity, of burning the manure before it is mixed with the soil.

I am not aware of the exact circumstances, as there has been no agricultural chemist in the employment of the Indian Government who could carry out the necessary investigations; but I could conceive of conditions brought about by moisture, wherein dung in an unburnt state might act as a direct detriment to tender plants in the early stages of growth.

We know that marsh gas and low forms of carbon, organic acids which injure crop plants, are produced by decomposition of humus in very wet soils where the supply of air is restricted. What the precise forms are that the injurious substances take I do not pretend to say, but from the evidence before me I can assert with confidence that there is a matter of importance tending in the direction indicated that deserves investigation.

On page 19 of the Thana Report it is stated that "the yield of the experimental plots manured with dung gave 50·9 per cent. of the standard (the cow-dung ráb plot), while the unmanured and unrábed plots showed 60·3 and 73·5 per cent."

The extent of the investigations, the evidently careful and unbiassed manner in which they were carried out, and the results recorded, enable me to attach greater importance than usual to experiments extending over such a short space of time. They are further confirmatory of native experience and explanatory of native practice.

The records of the valueless character of dung applied to soil under certain conditions in India must be looked upon as specially important in support of the theory which I have propounded, because the results were obtained independently, and before the theory, which had its origin in entirely different facts, had been thought of.

It is interesting to notice, further, what is related as occurring in a district of heavy rainfall, but under circumstances which vary materially from the above:—

"In the south of the Presidency (Bombay) the ante-monsoon storms are heavy, and allow of the sowing in May."

The moisture is not excessive, and in such tracts rice may be drilled or sown in seed-beds, *manured, but not rábed.* The early and more tender stages of the growth of the plant are passed without the manure being deluged to its injury.

In the case of the Konkan, rain does not come till June, and "there is a continuous downpour in June and July."

Kumri,[1] **or Dalhi,** is a wasteful process, which resembles ráb in a remote fashion, and is carried on by the wild or semi-nomadic hill-tribes of Western India. The jungle is cut a month before the June rains come, and after the loppings are quite dry they are burnt on the land. The wood-ash left may be mixed with the soil by means of a pick-like hand plough, *kudal,* or the seed of some coarse grain like ragí may simply be sown on the ashes at the advent of rain, and left to grow. A new piece is generally

[1] *Juming* is the name given throughout the hill tracts of India from Kashmir to Burma.

broken in each year, but at times two or three crops may be taken in succession before it is allowed to return to rest in a state of Nature.

"Ráb[1] ceases on all sides where the peculiar conditions of ráb tracts are wanting. Thus in the Karnátak, outside the Mallad, and to some extent inside its limits, water storage facilities exist. Here rice is drilled in terraced fields, and advantage is taken either of heavy showers in May, which enable the seed to be sown and a good start to be made before the burst of the regular rains, or of irrigation water stored in tanks by which the fields are flooded and the seed sown before the rains begin. This is the mode of cultivation in the rice tracts of Dhárwár and Belgaum. The variety of rice is different from that grown in ráb tracts. It is inferior, and has lost some of the characteristics of an aquatic plant. This is clear, because if the early rain is not propitious, jowári, a dry crop millet, *can* be grown instead of rice. Occasionally rice is seen on one terrace and jowári on the next, and even rice and jowári are sown in the same field. In Gujarát, where rice is grown in low-lying lands embanked as in the Konkan, the seed is raised in seed-beds manured but not rábed. This cultivation even is possible, owing to local peculiarities of rainfall, when irrigation is not available, but a large proportion of the rice in Gujarát is grown either under tank and well irrigation or as a pure dry crop. In the latter case it is drilled as in Dhárwár and Belgaum, but here (*i.e.*, in Broach chiefly) it is a row crop in cotton fields. This short account shows that rice, essentially an aquatic plant, is grown even as a dry crop. The extremes are met with in the row crop rice of Broach and in the salt marsh rice of the Konkan. In the latter case the seed is sown broadcast and left to grow where it falls. The seed is treated before sowing to cause artificial germination. Where the land is very salt it is not touched till it has been inundated by the rain. It is then stirred with the bullock hoe, and the sprouted seed is sown on the surface of the water.[2] It falls to the bottom and takes root. It will stand complete immersion for ten days. Sometimes it is sown from boats. Where the land is less salt, it is carefully picked with the hand hoe in the hot season and left in the rough till the rain falls, when the sprouted seed is sown broadcast."

"The artificial germination of the seed, which is not confined to salt rice, or even to rice, is caused in several ways"—as by wetting it with cold or, at times, with warm water.

[1] The above quotation is from the proofs of an Atlas in the press, by E. C. Ozanne, intended for the use of officers in famine times.

[2] This corresponds somewhat to a system which prevails in the Po Valley in N. Italy.

"One interesting method of cultivation is practised in Ratnágiri and Kánara, with hot weather rice, generally a late crop after the reaping of the monsoon crop of rice. The field is kept flooded to kill weeds for a time. The water is drained off. Manure is applied, and the seed sown in December. It is watered from time to time, and ripens in March. The water is brought from a dammed up stream or from a well or tank. This is called Váingan rice."

CHAPTER XIX.—CROPS.

Millets—(*a*) Juár, (*b*) Bájra, (*c*) Ragí—Common Gram—Horse Gram—Múng Bean—Lentil—Cajan Pea—Oil Seed Crops—Do. by Bhimbhai—Sugar Cane—"Beheea" Sugar Cane Mill—Evaporating Pans.

MILLETS.

THE **three most important Millets** grown in India are represented on Plates L., LI., and LII.; two large ones, *Juár* and *Bájra*, and the smaller, *Ragi*. Other millets of minor consequence are grown, but in a notice necessarily so brief as this they are not of sufficient importance to call for special reference.

Millets are more extensively and generally used as **food** by the poorer classes of India than any other grain. A recent Government Return shows that considerably over 80 per cent. of the food-growing area in Bombay, Berar, and Mysore is under millets, while in none of the important divisional areas—excluding Bengal and Assam, the great centre of rice cultivation—does the extent of millet fall short of one-third of the total breadth of crops planted. Millets supply rather inferior foods, both as regards digestibility and powers of nourishment, the nutrient ratio given by Church being,—

Juár,	. .	1 : 8·25 ;
Bájra,	. .	1 : 7·6 ; and
Ragí,	. .	1 : 13.

Though they may be grown under irrigation, yet they naturally thrive on unirrigated land.

GREAT MILLET OR JUÁR,

Sorghum vulgare, Pers.,

Plate L.,

The Cholum of Madras, and also known by sundry local designations. Of this there are many varieties, differing in colour of seed—red and white—and in size of plant. Juár is a kharif crop, generally sown soon after the early June rains—beginning immediately after the cotton has been planted. I was in time to see it sown in Khándesh, where it was being drilled, 3 lbs. of seed per acre, as the sole crop. This is the millet selected as best suited to the heavier descriptions and more humid classes of soil. It grows a heavy bulk under irrigation, though naturally a dry land crop, being usually sown along with some other crops better able to withstand drought, so that should the season be unpropitiously dry they may occupy the surface; whereas, if there is a good supply of moisture, the juár takes practically full possession, in virtue of its large and overpowering growth. The straw from the ripened crop is useful fodder, but the plant is sometimes grown for green forage, and cut while young. **It is said to poison cattle** in seasons when the water supply is not sufficient to support it in a healthy state.

BULRUSH OR SPIKED MILLET,

Pennisetum typhoideum, Rich.,

Plate LI.,

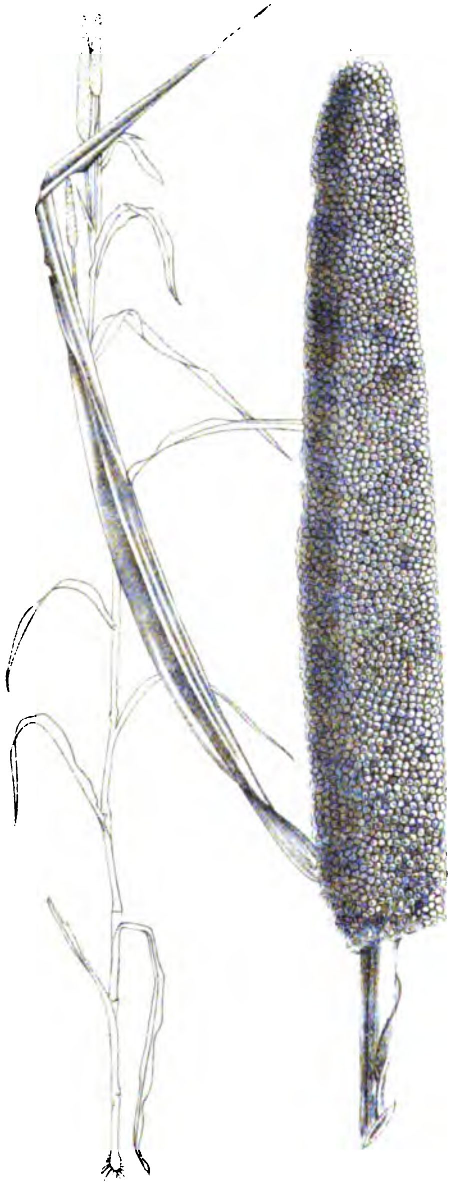
Also called Bájri and **Bájra.** Of this there are not so many varieties as of juár. It is the crop of the lighter descriptions of dry crop soils, and, as one would naturally suppose, it does not require so much moisture or occupy the land so long as the heavier soil crop juár. I had the opportunity of taking part in the sowing of this crop in

Plate 50.

SORGHUM VULGARE, Pers.

(Juár or great Millet.)

Plate 51.



PENNISETUM TYPHOIDEUM, RICH.

(*Bájra or spiked Millet.*)

Plate 52

ELEUSINE CORACANA GÆRTN.

(Ragi.)

Khándesh, where 5½ lbs. of seed per acre are drilled by the three-tined native drill, and as much as 3 to 4 acres are sown by one drill in the day.

Juár and Bájra seeds are grown for exportation as well as home consumption. Nearly a quarter of a million cwts. of the two grains has been annually exported in recent years.

RAGÍ,

Eleusine coracana, Gærtn.,

Plate LII.,

Also called Nagli, Nachni, Mandua, Marúa, etc., is the most inferior of the three millets, and, when taken alone, does not afford sufficient nourishment for the support of a healthy population. It is hardy, and will grow good crops under favourable circumstances on very poor soils. It is extensively cultivated on some hilly regions. **It occupies the first place as a food grain** in Mysore, and enters largely into the food of the people supported on the non-irrigated tracts of Madras, and also in Northern India.

It is not adopted as a food because of any special favour people have for it, as they would really prefer other grains, but because it grows well under unfavourable conditions, and is consequently extremely cheap in the market. It is the dry land cereal of districts of heavy rainfall, where rice is the wet crop.

PULSES

Of many species and varieties are grown in all parts of India, usually mixed as subordinate crops with grains, etc. Pulse seeds are parched or ground, and used along with millets, rice, wheat, and barley to raise the albuminoid ratio of the food of the people. Although the export trade is a growing one, the internal trade is of infinitely greater magnitude and importance.

Common Gram or Chicken Pea,
Cicer arietinum, Linn.,
Plate LIII.,

Belongs to the vetch tribe. It is grown as a rábi crop, and is generally sown alone, but sometimes with other seeds. In Northern India, on the light soils, it is mixed with barley; and on soils of the heavy class, with wheat. Gram is one of the crops which are rarely manured. It is universally regarded as a good preparatory crop for wheat, supplying, like clover, manure to the land, and keeping down the growth of weeds. It is commonly represented by two varieties, large and small. The amount exported during the last four or five years has ranged between 300,000 and 400,000 cwts. It is grown chiefly as an ingredient of the food of horses or cattle and of the poorer classes, but it also enters into the dietaries of the wealthy native population. I had it presented to me for lunch in the train by a Brahmin judge on my return journey from Madras to Bombay.

It is cooked in the following way:—The finely-ground flour is made into a thin paste, and passed through perforations in the lid of a pot containing boiling ghi. It is thus formed into little pellets, about the size of a pea, in the same manner that shot is formed from molten lead. The pea-like masses of dough as they get cooked in the ghi acquire greater consistency, and remain separate. After being drained out they are dipped into sugar, also melted by heat, and on being removed from this are rolled into balls about the size of a hen's egg while still retaining their nodular form. The film of sugar on the outside acts as the adhesive agent. The result is most palatable. The addition of sugar and oil to the richly albuminous gram makes an excellent food. The albuminoid ratio of the unhusked peas is 1 : 3·3 (Church).

Plate 53.

CICER ARIETINUM, L.

(Gram or Chicken Pea.)

ERVUM LENS. L.

(Lentil)

Horse gram, *Dolichos biflorus*, Linn., *Kúlthi gahat* (Hind.), *Kurti-kalai* (Beng.), etc., etc., is the leguminous plant usually known by the name of gram in Madras. Though used as food in much the same way, it is quite distinct from the common gram. Its straw provides valuable fodder for cattle. As cattle foods the seeds of the so-called grams hold a position which corresponds to that of British peas.

The Múng bean, *Phaseolus Mungo*, and some of its typical associates are sometimes, on account of the colour of their seeds, called black, green, or yellow gram. Some of these afford highly appreciated food substances. This is a kharif crop.

LENTIL,

Ervum lens, Linn.,

Plate LIV.,

Called Masur, Mussuri, etc., etc., is also a vetch, which occupies in Indian cultivation and as a food-stuff for human consumption a position very similar to that of gram. In Northern India, where it is most extensively cultivated, it seems to be best suited to the more humid regions. Lentil meal is richer in albuminoids than bean-meal or pea-meal, but heating in its effect as a food (Church). As an ingredient in mixed foods, it is a valuable addition in districts where the staple grains are deficient in flesh-formers.

CAJAN PEA,

Cajanus Indicus, Spreng.,

Called also Dal. A variety commonly grown in Northern India goes by the name of **Arhar,** while that seen in Bombay is called **Túr.** Here túr becomes dal after it is split in preparation for food. This is a large, upright growing, leguminous crop, occupying an important position among Indian pulses. I saw it planted in Khándesh, with the object of smothering weeds on land which had got too foul to be cleaned in the usual way.

OIL-SEED CROPS.[1]

In addition to the oil-bearing castor seed, poppy seed, coco-nuts, and the fruit of the Mahúa tree, *Bassia latifolia*, the four most important crops yielding seeds from which oil is pressed are linseed, rape, til or jinjili, and ground-nut. Only the two latter demand special notice.

Til, *Sesamum indicum*, is a crop specially grown for producing a pure sweet oil resembling olive oil, and used in India as an ingredient in food. Occasionally it is used to anoint the skin, a practice of which natives are extremely fond.[2] It is also used medicinally. Of this crop there are two varieties. It is a kharif, dry land crop, usually sown along with cotton or the large millets. The unpressed seeds are also used for food. The stalks are burned as fuel.

Ground-nut or Pea-nut, *Arachis hypogæa*.—This plant resembles a large clover. It matures its pods under the ground. I found it extensively grown in Madras in North and South Arcot. The seed contains 50 per cent. of oil and 24·5 per cent. of albuminoids (Church). It is largely grown for export. Pondicherry and Cocanada are two important centres for the export of coarse castor-seed and ground-nuts. The latter go chiefly to Marseilles and England. The oil is used to adulterate inferior olive oil. Castor-seed goes mostly to Moscow in Russia *via* Odessa and Sebastopol. The residue of ground-nuts from native oil-mills is extensively used in Madras for feeding work cattle. *Vide* page 63.

O'Conor's Review of the trade of India, 1886–87, shows

[1] Watt says, "There are over 300 plants known in India to yield oils or perfumes."

[2] Mustard oil and coco-nut are the chief oils used for anointing the body.

the exports of oil-seeds for that year, stated in millions of cwts., to be—Linseed, 8·6; rape, 2·6; til, 2·1; other sorts, 2·3. The export trade in oil-seeds has practically doubled in ten years, and quadrupled within twenty years. The removal of the export duty on oil-seeds in 1875 gave a wonderful impulse to this branch of trade.

Kerosine oil is now almost universally used for lighting by the native population. The total amount imported into India in 1886–87 approximated closely to 31 million gals., being an increase of fully 13 million gals. over the previous year's returns.

The following communication on the sources of the edible oils in Bombay Presidency I received from Rav. Bahadur Bhimbhai Kirparam, Assistant Director of Agriculture for Bombay. I print it, not only because I think it interesting and instructive, but because it supports my already expressed idea of the importance of oil as an ingredient in native food.

Almost all edible oils are pressed from what are called the oil-seeds, except cocoa-nut oil and cocum butter Of these oil-seeds the Deccan produces the largest and the Konkan the least quantity. In 1886-8˜ in the Presidency, excepting the province of Sind, 1,793,375 acres, or 8 per cent. of the gross area cropped, were under different kinds of oil-seeds, of which the following are the most important,—*sesame* or *gingelly*, *niger seed*, *ground-nut*, *safflower*, *linseed*, and *rape*.

Sesame, vern. **Til,** *Sesamum indicum,* of three varieties—black, white, and grey—is grown all over the Presidency, and has the largest area under it in Khándesh. The oil is used in cookery, and is preferred to all others. The oil-cake, which is largely given to milch and draught cattle with advantage, is eaten by the Deccan Kunbis with salt.

Niger-seed, vern. **Khurásni,** *Verbesina sativa,* is most common in the Mávals and western Desh. Its oil is cheap, and is largely used in cookery by the poorer classes, and in the adulteration of sesame oil. Its oil-cake is much prized for milch cattle.

Ground-nut, vern. **Bhuimug,** *Arachis hypogæa,* is mainly grown in the Deccan. The ripe nut, though sometimes eaten boiled or parched, is more used for expressing oil, which is considered the best substitute for olive oil, and is largely adulterated with sesame oil. The cake and the leaf, which is something like clover, are excellent food for cattle.

Safflower, vern. **Kardai,** *Carthamus tinctorius*, of two varieties, hirsute and smooth, is grown everywhere except in the Konkan. As a rule, the hirsute or thorny variety is the oil-seed, while the smooth variety is the dye-plant. The young leaves are eaten as a pot herb, and the cake is given to cattle. In Gujarát the oil is much used to adulterate other oils and ghi.

Linseed, vern. **Javas** or **Alsi,** *Linum usitatissimum*, grown as an oil-seed and never for flax, is chiefly confined to the Deccan and the Karnátak. The seed is eaten in condiments and the oil in cookery. The cake is a cattle food.

Rape-seed, *Brassica napus*, is grown in small quantities in Gujarát. It is of two varieties, vern. **Sarsav** and **Rái,** or the Indian mustard. The former yields a fixed oil for general use, known as the Colza oil of commerce, and the latter gives a pungent volatile oil only medicinally used. The oil-cake or residue from the former is a cattle food.

The other sources of edible oil are cocoa-nut and cocum fruit. **Cocoa palm,** vern. **Náral,** *Cocos nucifera*, is largely grown in the Konkan, and especially in the Southern Konkan, where the oil, juice, and scrapings of its kernel are largely used in seasoning dishes. In the coast villages of the Konkan, owing to the deficiency of milk, in certain dishes cocoa-nut kernel juice often takes the place of milk. Cocoa-nut oil is said to be cooling, and the people of the South Konkan are so convinced of this virtue of the oil that to rub it on the head is almost a habit with them. It is also used in adulterating ghi. The cake is used as a condiment by poor classes and given to cattle.

Cocum tree, vern. **Kokam,** *Garcinia indica*, is found on the Gháts of the Konkan and Kanara. The seeds yield a solid and rather friable oil, which is called cocum butter, and which is recommended for many medicinal purposes. It is used as an adulterant of ghi.

What fat is to European food, so are edible oils and ghi to the native food. Both oils and ghi are largely used in Indian cookery, and the proportion of their quantities in the food of a native varies with his means; the richer the man, the smaller the quantity of oil and the larger the quantity of ghi in his food. But it must not be supposed that oil has no independent place in Indian cookery, and is always used as a substitute for ghi by people in poor circumstances. There are certain dishes in which oil is invariably preferred to ghi. It is generally used in frying and seasoning vegetable dishes and fish, and some pickles are prepared with it. In parts of Khándesh and the East Deccan it is eaten with bread in the same way as ghi in other parts. In cooking flesh and preparing most of the sweatmeats, ghi and not oil, as far as possible, is used. It may also be noticed that the wild tribes who live on very poor food, such as coarse hill grain and wild bulbs and roots, use very little oil as such in their food.

It may be observed that the fattened and elliptical seeds of the melon, pumpkin, cucumber, and gourd family are capable of yielding a sweet edible oil. But in India the fruit is chiefly eaten as such, and not allowed to ripen its seeds for the oil supply. The nourishing properties of the seed are, however, not quite unknown to the natives. They are used in tonics by native physicians.

Lamp oils.—Besides the edible oils which are also used for burning, lamp oil, which is not edible, is derived from castor seeds and the berries of Alexandrian laurel.

Castor seed, vern. **Erandi,** *Ricinus communis*, is grown all over the Presidency. The oil, which is more used as a lamp oil than medicinally, is extracted in many places by the cultivator himself, by boiling the bruised bean and skimming off the oil as it rises to the surface. The oil-cake is not edible, but is a very valuable manure for garden cultivation, and is in constant demand in the Konkan and in the garden tracts of Surat.

Alexandrian laurel, vern. **Undi,** *Calophyllum inophyllum*, is an evergreen tree abounding in the Konkan. The berries when shelled yield a large quantity of greenish oil which is chiefly used for lamps and for caulking vessels.

SUGAR-CANE,

Saccharum officinarum, Linn.,

Plate LV.

This is a perennial grass, and is the chief source from which sugar is procured throughout India. In some parts of Bengal sugar is got from the Indian Date-Palm (*Phœnix sylvestris*); in parts of Bombay from the Palmyra or "Tal" (*Borassus flabelliformis*); and in parts of Madras the Coconut or "Pol" (*Cocos nucifera*). **The Chinese sugar-cane** (*Sorghum saccharatum*) has been tried in India, but, as a source of sugar, without success. It supplies a large bulk of green forage when well cultivated and highly manured.

There are many varieties of sugar-canes, which may be divided into four classes,—(1), "Large white or yellow cane; (2), Large red or black cane; (3), Striped or streaked cane;

and (4), Straw cane." This is E. C. Ozanne's classification for Bombay Presidency, but it may be fitly extended to other parts, with the rider that under the four heads are embraced considerable variations of size and quality, depending so far upon the conditions under which the crop is grown. Some are soft and juicy, and are eaten raw as sweetmeats, being cut into convenient lengths, and sold in the bazaars for that purpose. Others are hard, and fit only for squeezing. Sugar-cane is more generally grown as a crop in rotation than from year to year on the same land.

Manure.—This is the crop which generally receives the greatest amount of manure, except in excessively wet districts.[1] The manures applied are dung and the ashes of all sorts of substances commonly burnt, including those of the spent cane used in evaporating the sugar juice. The solid residue from oil mills, as from castor seed, also tank mud, and *poudrette* are employed, where available, in special cases. A green manuring is sometimes given, as in Gujarát, by ploughing in a crop like tág, *Crotalaria juncea*.

February is the month in which cane is most frequently **planted**, but there are exceptions. In Surat it is often put in about the end of the year, and in May at Kelva Mahim, in the Konkan.[2] At the latter place, by the kindness of Dhondo Vinayak Dhandakar, I was privileged to see the operation in one of the most productive and best managed garden districts in India, where the fertility of the land—more due to high cultivation and skilled management than to inherent natural qualities—could compare favourably with any in this country.

[1] Speaking of Bassein and Mahím, in N. Thana, Ozanne says:—"The climate is too moist to allow cattle dung to be well kept. It is all used as Ráb." Duthie and Fuller say:—"Sugar-cane land is invariably manured, except in certain tracts of the Himalayan Tarai, etc., where the ground is saturated with moisture." Two cases which tend to support my statement, that for some reason dung does not act properly in excess of moisture.

[2] It is believed that there are distinct races of sugar-cane suitable for planting in different seasons, but the subject has not been worked out.

Plate 55

SACCHARUM OFFICINARUM. LINN.

The area of cane cultivation in India, according to the last returns (excluding Bengal and Ajmere), was under 1½ million acres, of which considerably more than two-thirds were within the North-West Provinces and the Punjab. With a few exceptions, though in moderate quantities, cane is pretty generally met with in all parts. It is essentially a water-loving plant, and is found growing in greatest luxuriance in regions which possess a good water supply.

Some varieties, such as the "straw-cane," **grow on dry land,** and with nothing but the ordinary rainfall for moisture. I saw some excellent crops of dry land cane growing in the Santal country, and was assured that there was a possibility of largely increasing its area if the cultivators had the necessary capital.

The soil is generally well worked, being ploughed at least a dozen times, in addition to clod-crushing operations.

Planting.—In some parts the cane crop is sown broadcast, but the most remunerative common practice is to plant it. Plots or beds, 6, 8, or 10 feet square, are marked out and surrounded by earth bunds a few inches high, and intersected by channels to give command of the irrigation water. The cane sets or cuttings, which have from two to three nodes—the budding centres—in each, are buried in the bottoms of furrows, about 18 inches wide, dug in the beds, say one set going to each foot, and placed in such a way that the buds come out from the sides, not from below or above. I saw at Mahim beans planted at the same time as a catch crop on the ridges. They were cut for forage after they got over 6 inches high. With the exception of the dry land cane cultivation, considerable skill is necessary to keep the land sufficiently moist without waterlogging it. To secure this in dry seasons water is let on every few days, the time varying according to conditions in different districts, from three or four up to ten or twelve days.

Flooding is one of the most serious sources of injury to cane in excessively wet seasons.

Damage being done to the softer and more succulent varieties of cane by jackals biting it, the lower withered leaves are tied round the stem for protection, and the crop has to be watched night and day.

Weeding may be done partly with bullock hoe and partly by hand. When the cane is large enough, say two or three months after planting, the **ridges** between the rows are **split**, and used to earth up the roots of the plants. **The crop is removed** usually by pulling, according to custom, at from nine to twelve or thirteen months. At times a second or *ratoon* crop is taken from the stools left when the first crop is cut, but the yield is much less, and it is not considered good practice except in cases of emergency. The terminal green leaves make excellent **fodder**.

The most successful cane-crushing mill is called the "**Beheea**,"[1] brought out by Thomson & Mylne at a cost of Rs. 165 to Rs. 170 for the large, and Rs. 70 to Rs. 100 for the small variety. Over 70,000 are in use, having to that extent replaced the old wooden roller mills, the *Charak* of Bombay, and the *Belna* or *Gundi* of Northern India, and also the *Kolhu*, which is constructed like a pestle and mortar. The Beheea mill is shown on the opposite page in two forms, Fig. II. being the 2-roller variety suitable for small cane, and worked by one bullock; Fig. I., the 3-roller or double-squeeze variety, for crushing large cane by a double operation. It is worked by two bullocks, which, however, ought to be changed frequently. The Plates show the details of work so plainly that a printed description is unnecessary.

I had a double object in reproducing the plates from originals, kindly supplied by Mr Mylne—(1.) To make known the form and simplicity of the mill; and (2.) To draw attention to the fact that the rapid and extensive

[1] The new spelling of the place giving its name to this mill is Bihiya.

adoption of this machine is an everlasting monument to

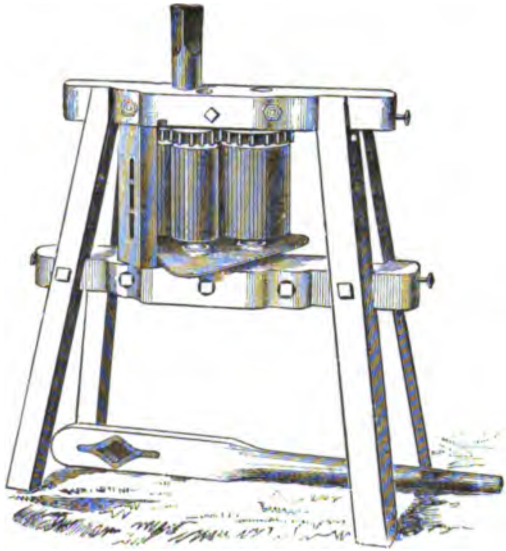


FIG. I.

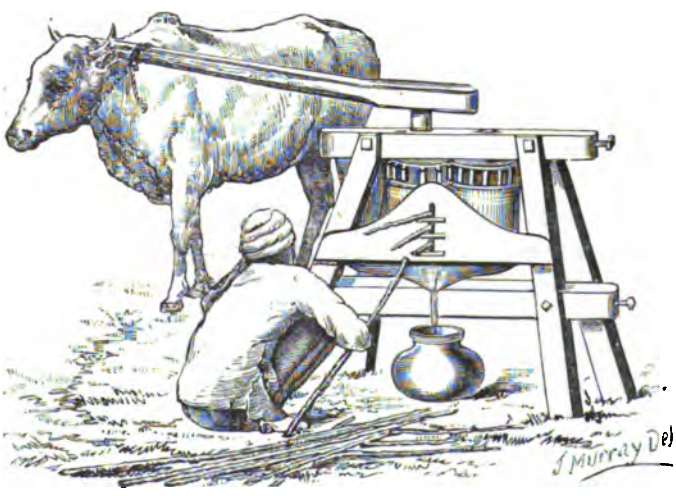


FIG. II.

the ridiculous absurdity of the statement, that it is ignorant prejudice which prevents the ryot accepting proposals or suggestions made by Europeans with regard to changes in their methods of working. The way the sewing machine has been taken up by the village tailor throughout India is another proof of what I say as regards the possibility of introducing changes when these are improvements.

My experience throughout, without even a single exception to the rule, showed that the ryot will not reject any proposal that he can see will turn out for his benefit, but at the same time he will treat with silent indifference, without troubling to give his reason, any attempt to establish a practice which would not suit surrounding circumstances, however feasible the proposal might look on paper to those who were unaware of the practical facts.

The great secret of the success of the Beheea mill is that it was originated under the light of a knowledge of the requirements of the case, and at the same time a knowledge of the defects of the mills that had been in use. It is, further, an improvement of a native mill of a somewhat similar pattern, not an entirely new invention, or something copied from the European world. Taken as a whole, the Beheea mill, with its simplicity and its success, shows unquestionably the lines upon which all efforts must be made to bring about the social revolution which is being sought after in India.

Small cane-growers club together in the Bihiya district to help one another with their work, and also to purchase bullocks and a mill as company property. The mill passes from place to place for a few days at a time in each case.

Should one man's cane begin to get too ripe near the end of the season before his turn comes round again, he irrigates it, and sets it growing. Cane-squeezing begins in October and goes on till the end of March.

Over 70 per cent. of the sugar-cane can be **extracted as juice** under favourable circumstances.[1]

[1] "The portable Beheea mill having a pair of rollers 8 in. long, 7 in.

The juice may be drunk fresh, but it is mostly evaporated into *Gul* (Bombay), *Gur* or *Râb* (Northern India) = crude or concrete sugar, containing, according to the method of making, whether native or improved, from 68 to 85 per cent. of crystallizable sugar.

An iron mill, the ingenious invention of a native, exists at Poona, and I also saw a horizontal roller mill at the Khándesh Farm. For both even greater merit is claimed than that of the Beheea; but, on the principle that "nothing succeeds like success," I give the palm to the latter.

Flat iron or copper evaporating pans take little more fuel than the spent cane supplies, while the deep and narrow pans found in a few districts are much more wasteful. At Nagpur I saw a flat pan of more than average ingenuity and usefulness. Its shape was somewhat on the pattern of a salmon ladder, and it was so arranged that the juice flowing in at one end, slightly raised, was evaporated in its tortuous course sufficiently to be ready to discharge on its arrival at the lower end without having stagnated by the way. Locally the juice is consumed in this condition.

A centrifugal machine has recently been invented by Thomson & Mylne, for separating the molasses from the product of the evaporating pan, and bids well, so far, as a rival in success to their crushing mills.

In sugar there will always be a large *internal trade* in India, as natives are extremely fond of sweetmeats, and it may be said to assume the position of an important ingredient of food. It is estimated that more than 2,000,000 tons of crude cane sugar are annually produced in India.

diameter (weighing less than 5 maunds), worked by a single bullock, extracts 70 lbs. juice per 100 lbs. Bengal cane (averaging an inch in diameter); and, with the rollers going 9 feet per minute, crushes 400 lbs. per hour. The double-squeeze mill having two rollers, 8 in. by 7 in., and one 8 in. by 4½ in., extracts 73·4 lbs. juice per 100 lbs. cane in one operation, crushing 480 lbs. per hour."

An import duty of 5 per cent. on sugar was removed in the spring of 1882, and since that time the volume of the import trade has increased nearly threefold. The imports (mostly refined) from the Mauritius were in 1886–87 1,377,000 cwts., or within about 370,000 cwts. of the total imports of sugar for that year. The total exports for the corresponding period amounted to 986,000 cwts., largely consisting of gûr or raw sugar. These figures show a shrinkage in this branch of trade of 644,000 cwts. (considerably over ⅓ of its volume) within three years, which seems rather a serious matter if it has been produced by the removal of the import duty.

CHAPTER XX.—CROPS.

Indigo—Growth and Manufacture—Tobacco—Growth and Preparation—Pusa—Nariad—Dindigal—Means of Improving Indian Tobacco—Culture and Curing of Tobacco in America—The Mango—Wild Species—Cultivated Varieties.

INDIGO,

Indigofera tinctória, Linn.

Plate LVI.

THIS **is an industrial produce crop,** which is most extensively cultivated in Northern India along a belt of country lying to the south of the northern mountain range. It is frequently made to follow sugar, which is a well-manured crop. According to the last Government returns, which do not include Bengal or Ajmere, there were not quite a million acres in India under indigo, and those mostly in the North, with the one exception of any consequence, Madras, which grew nearly 300,000 acres. On account of there being no Government returns for Bengal, I adopt the figures given in Dr M'Cann's Report on the "Dyes and Tans of Bengal," which shows the area under indigo to have been 710,000 acres a few years ago.

In Northern India it is generally **sown in February** by the natives, as by so doing it costs less labour, although the yield is not so good as when sown in December by British planters. The December sown crop is **pruned** in spring to encourage it to branch. After the first cutting has been removed, a second crop may be grown from the old roots for **seed,** and cut before the end of the year.

The yield is much reduced if weeds are allowed to grow, as when the crops are carelessly weeded. A good yield per acre, cut before flowering, is about 8 to 10 tons—poor crops are much less—and the produce strongly resembles green Lucerne, *Medicago sativa.*

Cutting had begun early in July when I visited the localities referred to—Samastipur and Bihiya. The indigo **harvest** was reported to last only some five or six weeks. The great **enemy** of indigo cultivation is excess of wet, especially in the later stages of its growth. If there is too much rain and too little sunlight, the dye material does not form in the leaf. Great anxiety was being felt on this account in the indigo district traversed by the railway going to Dárjíling when I passed through it in the end of June. The prospects up till that time looked unusually good.

The crop is carted to the indigo factory immediately after being cut. Each load is weighed, and **packed into a tank** about 5 feet deep, and the whole kept down by three strong beams resting across a series of bamboos laid on the top. It is then **flooded** with water, and left to **ferment** for twelve and a half to thirteen hours—the rapidity of the action depending much on the weather. It is extremely important that this process should stop at the right time, to prevent loss of material if underdone, or the reduction of quality if overdone. During the continuation of the action, which is associated with bubbling up, the bulk has a **tendency** to **swell**, and the edge of the water where it touches the cross beams is convex, and stands up as a little wall. So soon as it begins to **shrink**, and the edge of the water becomes concave, owing to the fermentation being past its height, the liquid, which should then have extracted the dye from the leaf, is run off into a large tank at a lower level. **Its colour** is then like a muddy river, but with a greenish-blue tinge in addition.

Oxidation is the object to be attained in the second tank.

Plate 56.

INDIGOFERA TINCTORIA, L.

(Indigo)

This is accomplished by beating the water to cause agitation and free exposure to the air. The original method was carried out by men standing in the liquid and beating it by hand. Recently a mechanical beater, shaped somewhat like a common undershot waterwheel, is substituted, and performs the work required for one charge of the oxidizing tank in about an hour. **Two hours** are necessary for the indigo to **fall** to the bottom. The liquid is then carefully run off from the top by holes in the sides of the tank, and the residue pumped into a third tank, and **heated** up to 210° F. From the cooking tank it is poured into a cloth-lined drainer, being subsequently pressed into cakes, and cut into cube-shaped blocks measuring $3\frac{1}{8}$ inches in length of side. The spent leaves and stems make excellent green manure, and the crop residue in the soil supplies food for a rábi crop of wheat or barley to follow.

Produce.—Of the crop as carted to the factory, 185 maunds should yield 15 sers of dry indigo, worth at the time of my investigation Rs. 200 per maund. A few years before it had been as high as Rs. 350 per maund. The price varied extremely according to quality; and even under the best systems of management, which after all were merely "rule of thumb," the quality varied much more than it ought to do under scientific superintendence.

In Madras the plants are dried in the sun before being put into the vats. This is called the *dry* process.

Need of Chemical Assistance.—The whole process, though extremely simple in the matter of its execution, is one which requires an intimate knowledge of the chemical actions taking place at the different stages to make certain of uniformity in the product. This is one industry which might be enormously improved by the aid of a competent Government chemist, who would require to conduct a series of experiments to find out exactly what actions do take place, and to formulate means for controlling them, or at least knowing each stage as it occurs.

Wherever there are fermentation processes and chemical changes of an important nature taking place, under circumstances which vary from time to time as regards temperature or climate, there must be serious loss, unless the management is under the direction of a scientific expert, or of workmen who have been instructed by an expert.

The likelihood of competition in the indigo market springing up from Tongking, which is supposed to be more favourably circumstanced than Bengal for the growth of indigo, is an additional inducement for Government placing within the reach of British growers that scientific help which in the immediate future will be a necessity to the existence of the indigo trade of India.

TOBACCO,

Nicotiana tabacum, Linn.,

Is very generally grown throughout India, but common tobacco is of coarse, thick-leaved, inferior varieties, and, as a rule, cultivated solely for local consumption. The native population use it extensively for smoking. Only in certain districts is it used as an ingredient to chew along with Betel leaves. From the last returns, which include Lower Burma, but exclude Bengal and Ajmere, the area of tobacco cultivation extended to 362,000 acres. The total export of tobacco, including cigars, was 10 million odd pounds. The character of the soil, and also the manipulation in curing and preparing the leaf, affects the sample in almost an incredible degree.

Very few **soils** in India are at all, so far as they have been tested, capable of growing good tobacco, and very little is known of the methods suitable for preparing it for the English market.

Climatic circumstances are adverse to its easy manipulation, and demand the expenditure of large sums of money to overcome the exigencies of the weather. Though admitting all those difficulties, there is little doubt but that they *can* be overcome, and that when knowledge extends, tobacco of very fair quality, suitable for the European market, will be forthcoming from India.

The one universal complaint against Indian tobacco is that it remains wet and soft—does not season properly when made into cigars, and is, in consequence of this and other defects in composition or character, **difficult to burn.** While growing it gets covered with **dust** or sand, which materially lowers its value through inducing improper fermentations and bad smells as the process of manufacture is proceeding.

The only centres of importance where tobacco is grown for the British market or the consumption of the European population in India are—(1), Nariad, on the line of railway a little to the north-east of Baroda; (2), Trichinopoli and Dindigal, at the foot of the Palni Hills in Southern Madras; (3), Cocanada, on the northern coast of Madras; (4), Kuch Behar or Rangpur district, lying directly north of Calcutta, near to the frontiers of Bhutan; and (5), Pusa, in Tirhut, a district lying due west of the last-mentioned place, near to the Nepal frontier.

The tobacco manufactured into the **Burmese cigars,** now gaining in reputation, is mostly grown in India,—Cocanada, and the islands which are conveniently situated off that coast, for supplying the Burmese market with the raw material.

At Pusa the tobacco growing and manufacture is carried on by Begg, Dunlop, & Co., who hold the old Stud Farm from Government on liberal terms. Neither the soil nor the climate are well fitted for growing really good or fine leaf tobacco suitable for Europe, and the undertaking cannot be said to have proved a success. The soil is deficient in lime, and possibly also in potash, and there seems to be too much ammonia—the plant becoming too strong and coarse. A better quality is grown in the Terai, on the way to Dárjíling, from Salligori up to 5000 feet of elevation. As regards moisture the climate is there more equable than at Pusa, where it is at times too wet and at other seasons too dry.

In connexion with Pusa there has also been tobacco grown at Ghazipur in the North-West Provinces, but it cannot be said with success.

Most of the tobacco leaf from Pusa is sent to England. Some of the finer "grades" are made into smoking mixtures, but the greater amount manufactured is worked up into stick tobacco for the army—molasses, liquorice, and spices being used to sweeten and make it milder. This is sold at Ans. 8 per lb., less 10 per cent.; cut mixtures fetch from Ans. 12 to Rs. 1 Ans. 12 on the same terms. The yield per acre of marketable leaf varies from 6 maunds to 12 maunds per biga.[1] Tobacco grown under favourable circumstances in this district, and properly cured, so as to command a market in Europe at 4d. per lb., would pay about 25 per cent. of profit.

At a certain stage of the growth of the crop the terminal bud or spike is broken off, and about a month later the leaves should be uniformly ready to cut for curing. Depending on the soil, the height may vary from 5 feet down to 15 inches, or even less on poor land. After cutting, the tobacco plants are hung up to dry in a large barn, which has abundance of ventilation, and that completely under control. About 4800 cubic yards of space are required for each acre of crop.

If too much dry air is admitted, the leaves dry too quickly and the colour is injured. If there is not a constant current of air, however, fungi are developed and the leaves rot. The mould may not be noticeable till the leaf is held up to the light and looked through, when internal black spots, which subsequently spread, are noticed. Drying for ordinary purposes requires a temperature of about 80° F.

[1] A maund = 80 lbs., and a biga = ⅝ acre imperial.

for the first four days; fine tobaccos should get quite yellow at this temperature. If then the heat is increased by 30° F. to hasten the drying, the tobacco should be ready in about six or eight days more. When this temperature is not available, the whole drying process may in good practice occupy a month. If the temperature is allowed to go down by mistake, the result is red leaf. The gradual increase of heat also gives a red leaf. In leaves being prepared for cigars, after the yellow colour is general, dark-brown spots appear, and gradually increase till the whole leaf is brown. After the stems have dried completely, so that they will crack through on bending, which may take, perhaps, eight or ten days, the tobacco is taken down from the spars of the drying-house, where it has been hanging tied in bundles (ten or twelve leaves in each) with the tips of the leaves downwards, and piled in heaps on the floor to encourage fermentation. Though the stem is dry and crackling, the blade of the leaf on each side of it should be moist by absorption, to keep it from breaking. The temperature of the heap rises with fine leaves from 110° to 115° F., or with coarse leaves even up to 135° F.; but this is regulated more by acquired skill than by fixed rule. The remarks are consequently very general. The heaps are turned twice when the material comes to about the temperature indicated, consequently it rises three times to the high temperature. At the third time of turning the mass should be quite cool if the action has been right. The fermentation is the most delicate and the most important, and at the same time the most difficult part of the whole manufacture. To test if the fermentation has been good, a handful of leaves is pressed together while holding them up in the position of growth. When the hand is withdrawn the leaves should droop over and not adhere to each other or stand up. The leaves are next sorted into various qualities, according to length, colour, texture, etc.

Broom rape, *Orobanche*, which lives by sucking the juices from the roots of the plant, is very abundant and destructive on land that has been continuously cropped with tobacco.

At Nariad the praiseworthy, though for long futile efforts of Rao Bahadur Bachardas Viharidas to improve the practices of tobacco growing in Gujarát seem at last to be approaching success. The tobacco is mostly grown on a farm of 1800 acres, situated about seven miles from Dahore station, and leased from the Government at a moderate rent, under the stipulation that 200 acres of tobacco are annually cultivated. A drying shed, 230 ft. by 64 ft., had been built at a cost of Rs.25,000, but without any control whatever over the ventilation. As this in successful practice requires to be regulated both by night and day to the greatest degree of nicety, the result was a foregone conclusion—a failure. The colour was spoiled, and long before the stems were dry the blades of the leaves were so dry and brittle that they crumbled on being touched into a condition resembling that of snuff.

The tobacco plants grown from seed imported from America and Java are reared on heavily manured seed-beds. *Joke*, or cow-dung in a dry and powdery condition, made at the season when the animals are in the house, is used, and a shelter of boughs erected over the space occupied by the beds. The sowings are made at intervals of a few days, extending over six weeks or more, so as to have seedlings coming forward at different times. On 26th May fully half the seed had been sown, and the young plants were watered morning and evening. This was earlier than usual, and was intended to be so, to get the crop earlier ready, and to come in for drying at a season which was not extremely dry. I learned afterwards that the early sown plants were rotted by excess of wet, and some of the recently sown beds were washed away a few weeks later at the burst of the monsoon, thus exhibiting one serious practical difficulty in the way of altering the usual time of planting. Within a week after sowing two little rounded cotyledons appear, and in about five days more a third leaf follows. The seedlings are ready for transplanting in forty to forty-five days after the seed is sown, and when the leaves are about the size of a florin. The crop is cut about ninety to ninety-five days after transplanting. That grown for native consumption is allowed to stand for five months. The best tobacco soil is of a light rather than a heavy nature. The lighter descriptions of black soil grow leaves of fine quality. Soil newly broken in requires no manure. Cow-dung (thirty carts per acre, weighing 500 lbs. each, dry) is given to the second crop, but bone dust or other concentrated manure would do equally well if available; 200 lbs. per acre of mashed bone was tried with success by Mr Bachardas's father. The usual width between the plants is 3 ft. by 2 ft. If the soil is very good, and if finer leaves but a higher crop is wanted, the plants are put closer together. A crop grown for the London market weighs 600 to 700 lbs. per acre when taken from the drying-shed.

The leaves are arranged into long, short, black, brown, yellow, and broken, to suit the market. **In cigar making** the broken leaf is packed inside, and the first and second wrappers made of the darker shades of leaf, the outer one being of the finest texture. The brown and yellow leaves are used for pipe tobacco and cigarettes.

Bird's-eye tobacco is made by cutting up the whole leaf. In all other tobaccos, including cigars, the mid-ribs of the leaves are removed.

The leaf at the tapering end of the cigar, which is the finishing point in rolling, is fixed with a little arrowroot or some sort of starch.

Hand-rolling is found to serve a better purpose than rolling by machinery in India, as with the condition and character common to Indian tobacco the latter system is apt to turn the cigars out too firm, with the result that they do not draw freely, and this, associated with the want of burning power in Indian tobacco, is ruinous.

The wages of expert rollers, who had been brought from Madras, were Rs. 1 per day. Boys were getting Ans. 8 per day; but it is expected that the wages of local workers when trained should not exceed half the sums named. A good roller and a boy arranging the packing material for him turns out about 250 cigars daily.

Artificial flavouring is usually a secret of the trade—at least as regards the proportions of substances used. These substances are the essential oils of different barks, flowers, nuts, beans, etc. The following common substances are also at times applied, either sprinkled over the tobacco leaf, or in solution before it is cut, or rolled, as the case may be: saltpetre (nitrate of potash), to make it burn and to give it a white ash; alum, to give a white ash and to assist in the removal of hairs and dust, much used in Burma for ladies' cigars; common salt, to give a sweet taste and also induce moisture in virtue of its magnesia salt impurities (cavendish has salt among other flavourings); sugar, to give sweetness and burning power. The juice of the sugar-cane is at times used. At Nariad a solution of the sugar from the Palmyra palm is sprinkled over the cigar leaf, while that for smoking mixtures is immersed in the solution and passed through a squeezer to remove excess of moisture. In Burma coco-nut water is freely used in tobacco manufacture.

The prices of Nariad cigars vary from Ans. 12 per 100 to Rs. 3 per 100; for ordinary sizes the range is between Rs. 1 and Rs. 2.

At Woriore, a village in the suburbs of Trichinopoli, there is a number of flourishing cigar-rolling establishments under native management, and producing an article—the Trichinopoli cigar—which is well known in all parts of India.

At Dindigal, John Hempel, a Hungarian, has made the greatest financial success in growing tobacco for European consumption. He has within the last nine years built up a trade in cigar making which employs 300 men in the rolling department. The great secret of his success is that he is thoroughly practical, having mastered the German methods of working before leaving Europe. He has carried out a system, not of substituting European for native practices, but of *improving* the native methods of growing, curing, and manufacture by the light of his superior and more extensive knowledge. He arranges with the ryots to grow the leaf by their own methods, but under his direction or advice. The difficulty of the leaves becoming covered with sand or dust is got over by planting hedges for shelter and keeping the plots small.

The efforts directed towards improvements in the practices of tobacco curing in India have, as a rule, been begun at the wrong end and worked backwards, and, like the skene of silk tangled from a corresponding cause, will throughout be unsatisfactory.

The proper way to set to work, it seems to me, would be to send most carefully selected and reliable men, thoroughly trained in the best existing native practices, to countries where greater proficiency in the growth and manufacture of tobacco has been reached, there to go through a course of instruction which had been planned and laid out for them by qualified experts. **The object** is not to adopt altogether new methods, but to gain experience which would enable them to improve native methods when they return. The foreign experience is not meant to be kept as a thing apart by itself, but to be in the position of the graft of the refined and delicate apple on the stem of the native crab-tree.

It may be said that the principle involved is at variance with the principle advocated in the development of agricultural improvement, but the conditions are utterly different. The inducement for the European tobacco expert to conceal his ways of working from his native associates is great, because as soon as they become proficient, his employment would be at an end. There is no such inducement for the agricultural expert to hide his knowledge; it is all in the other direction. His term of service would not be a short one, and would not expire, however much he accomplished. The more he could teach those under him, the easier would his own work be. No doubt ultimately the same object would be attained; natives would be able to do most if not all the work of each department; but the change would be accomplished in the matter of agriculture in a space of time measured by generations, not by so many years, as in the case of tobacco. To show how the selfish personal tendency on the part of European experts, who are engaged for a short term, defeats the praiseworthy efforts of Government or of private enterprise, I shall give a special instance. I found one man in charge of a large concern in Western India. The native owners were dissatisfied with being kept in the dark in regard to certain details of importance. When I sounded the expert on the matter, his reply was, "Do you think I am going to teach those black fellows all I know, so that they may make use of my brains when I am gone? Not very likely!"

If Government, in carrying out a scheme of technical education, had once established, by aiding local efforts, various centres of tobacco manufacture on a basis fit to produce the materials suited to the European market, it would be a decided advantage to have periodical inspections made by men of very large experience, holding such positions—say, in the American tobacco trade—that their actions and reports would be placed above suspicion.

From the perusal of the excellent and exhaustive report published by the United States Government in 1884 on "The Culture and Curing of Tobacco," it will be seen with what detail and with what care every process connected with tobacco management has to be undertaken. And further, it will be acknowledged how futile it would be to attempt anything like a substantial improvement in the growth or manipulation of Indian tobacco without calling in the aid of chemical experiment to determine accurately the conditions present in India in both the growing and curing departments.

THE MANGO,[1]

Plates LVII. and LVIII.

The varieties of the mango in India are quite as numerous and variable as the varieties of apples and pears are in this country. They are descended from the wild mango (*Mangifera indica*, Linn.), which grows at an elevation of 2500 feet in Sikkim, and from another wild form belonging to the Kangra Valley to the east of the outer Himalaya Range.[2] Mangoes have been unconsciously improved by selection, through natives cutting down inferior trees when wood was required, and, of course, leaving the best sorts to reproduce the stock of the future.

Grafting is a comparatively modern practice, probably introduced from China.

Characters.—Almost every shade of colour is to be found represented among the multitudes of varieties. The variation in flavour is very great, from the distinctly turpentine taste of the inferior stringy or tow-like sorts to a refinement and delicacy of sensation on the palate which cannot be imagined, but can only be experienced.

[1] Plate LVIII. shows the fruits at half their linear dimensions; Plate LVII. rather under half. With the exception of those termed Sindurea (*Vermilion*), which were by Col. Waller, they were reduced from paintings by Maries, late gardener to the Raja of Darbhangah. I am also indebted to him for much of my information respecting mangoes. He has an elaborate work in hand on this subject.

[2] Watt says,—"The mango tree, Am or Amb (*Hind.*), Thayet (*Burm.*), a densely-branched, large tree wild on the Western Ghâts, the Chutia Nagpur Hills, and the Naga Hills."

The quantities of good mangoes to be had are increasing, no doubt owing to the encouragement given by the increased facility of transport to centres where remunerative prices are current. Calcutta, for example, in common with other important centres, draws great quantities of this fruit from Darbhangah and Muzaffarpur districts.

The price varies enormously according to quality, from 2000 per rupee to 4 fruits per rupee. The latter are the rare and fine sorts consumed by the wealthy; the former enter largely into the food supply of the poor population, both as fruit and as mango cake,—the sun-dried pulp having somewhat of the colour and texture of a raisin, the large, hard, and hairy-coated stone characteristic of the mango being removed, and all strings and unattractive solid residue being drained out in the process of manufacture. The mango season lasts five months, from the middle of May till October.

Three of the most famous mango districts are *Malda* and *Tirhut* in Bengal, and *Salem* in Madras. The famous Bombay mango does not belong to that Presidency, but was originally imported from Salem.

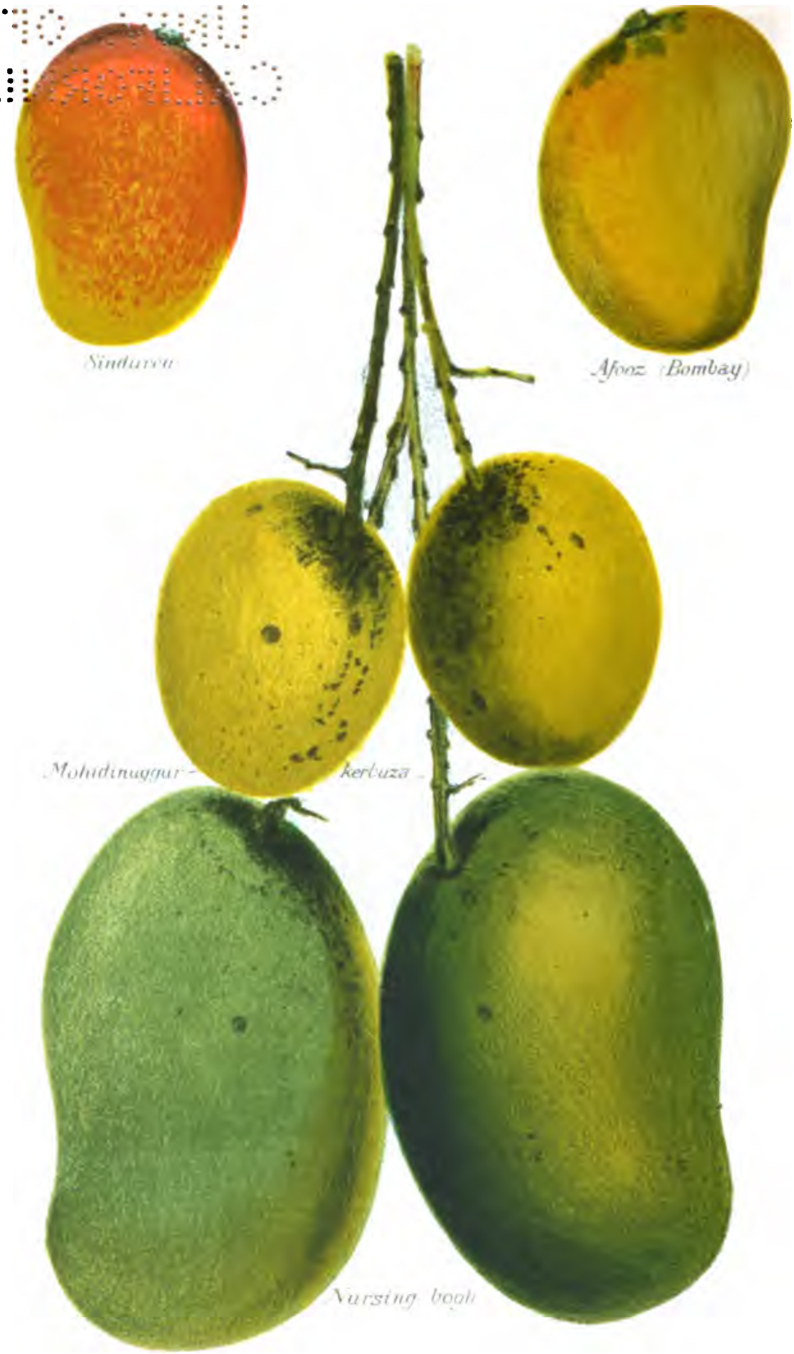
In each district a shape peculiar to it predominates. **In Malda** the shapes are much like that of the wild *Mangifera indica*,—all long, with more or less of a pointed form, and showing a dirty green colour. This forms the link between the wild and the most highly cultivated varieties.

In Tirhut there are upwards of 400 varieties, and half of these are very good. Others, though inferior in quality, are sometimes very pretty, varying from deep peach red to bright yellow.

Mangoes are at times **classed** according as the pedicel is depressed or raised above the surrounding part of the fruit.

Plate LVII. represents a group of four sorts: (1), *Ennurrua*, or spontaneous, from its having sprung up by chance, a name given by the present owner of the tree; (2), *Gobinpur*

MANGOES



MANGOES

sindurea, or the red mango of Gobinpur; (3), *Darrma;* (4), *Sáfed*, white.

Plate LVIII.—*Mohidinuggur kerbuza*, or the melon of Mohidinuggur, has the aroma and flavour of a fine musk melon. This fruit is extremely good, but rare. The two large green fruits below are also rare, and are called *Nursing bogh*, or the food of the god Nursing.

The Bombay or "*Afooz*" mango, usually corrupted into "Alphonzo," is a very fine variety, and one of the best known sorts. Seen in the high right corner of Plate LVIII.

The upper fruit to the left is called *Sindurea*, a term pretty widely applied to the common inferior forms seen growing on trees planted along the roadsides as shelter.

Though mangoes generally grow on trees—the inferior ones on the trees of largest size—yet at Kalia, to the east of Calcutta, I saw a very fine one of a rounded form, very solid in texture and of a dark colour, which I was told grew on a creeping vine. Maries calls it the creeping mango or "Luttea." It could hardly spring from the same parent as the common mangoes.

CHAPTER XXI.—CROPS.

Wheat—Races of Common Wheat—Spelt Wheat—First Arrival of Indian Wheat in England—Favourable Conditions for the Growth of Wheat—Wheat-growing Areas—Statistical Returns—Time and Method of Planting—Failure of English Wheat-growing Experiments—Average Crops per Acre—O'Conor's Review of Trade—The Marketing of Soft and Hard Wheats—Nisbet on the Various Kinds and Qualities of Wheat from India—Hard Wheats—Their Weakness—M'Dougall Brothers' Report of Experiments—Exports—Difficulties in Growing Wheat—Decreased Yield—Other Grains Exported—Wheat Impurities—Dell & Son's Method of Cleaning—Sources of Impurities—Pulling in Harvesting—Storing in Pits—Five per Cent. of Refraction—Cost of Production—Shipment from India in Bags.

WHEAT.

THE **common wheat of England**, *Triticum sativum*, is also the species most prevalent in India. Hard red, hard white, and hard yellow, also soft red and soft white, are all represented and grow in districts to which they are suited; nevertheless, I have seen a truly hard, and also a truly soft wheat belonging to the same head or stalk.

Spelt wheat, *T. Spelta*, vern. Kaplé, is another species represented, and classed as a hard red wheat. It is grown in Madras and also in Bombay Presidency.[1]

[1] Apropos of the above remarks, Ozanne, speaking of the wheats of the Bombay Presidency, says—"Hard white is the dry crop wheat (Hânsia) of all Gujarát, except certain parts of Ahmadabad; and of the Deccan (pivla). It shares with hard red the wheat tracts of Khándesh, while in that district hard white (Bansi) is also largely grown under canal, channel, and well irrigation. In the Deccan a very fine variety of hard white (Bakshi) is grown in the elevated plateau of Párner Táluka as a dry crop, and it is well known all over the Deccan and Bombay Karnátak as the best irrigated variety, though its growth is circumscribed by its great liability to rust, and in these provinces the result is that spelt, which is practically rust proof, is by far the most common

Wheat has been grown in India in certain districts for hundreds of years, but its cultivation was not specially remarked upon in this country until railways[1] opened up a road for its exportation, and until in the eighteen-seventies, it continued to be sent[2] in increasing quantities to Europe by way of the newly opened Suez Canal, which very materially shortened the time occupied in transport.[3]

Wheat is not universally cultivated on a large scale in India. It is more or less confined by natural limitations of climate to the north-western portion of the empire.

Wheat, like all of our common cereals, flourishes best where the supply of sunlight is abundant, yet it is better suited to regions of moderate temperature and moderate

of the irrigated wheats. The dry crop hard white has everywhere an occasional and sometimes a normal tendency to become bellied (potha) or soft. With heavy rain in December the percentage of soft grains is very large. In moist tracts the normal condition of the hard white is a semi-softness. The most characteristic semi-soft white is the Dáud Khâni.

"Hard red wheat is the dry crop wheat of Khándesh, and also of the Bombay Karnâtak, where dry white wheat is unknown. The spelt irrigated wheat has at times been in extraordinary demand on the Continent. It is a large cropper and a safe crop, but these advantages are somewhat counterbalanced by the adherent glume which necessitates pounding like rice to separate it from the grain. Hard red wheats of the Karnâtak are the best of the kind. Millers assert that the strength is diminished by irrigation of hard red wheat in Gujarât.

"Soft red is only largely grown in Ahmadabad and with irrigation.

"Soft white is only grown in the Mával táluka of Poona. Its area in Bombay is thus exceedingly small, and it is not susceptible of increase. Soft white from the Central Provinces and from Australia have been successively grown on experimental areas in Khândesh, but though the out-turn after the second year is very excellent, the change in consistency is enough to cause the merchant to class it as a mixed hard and soft."

[1] Railway mileage has increased as follows,—from 20½ m. in 1853 to 2519 m. in 1863, 5695 m. in 1873, 10,317 m. in 1883, and 14,510 m. by the last returns.

[2] The first English contract for Indian wheat was made early in this period by the firm of Harris Bros. & Co. A lot of 3000 tons was bought by them from Ralli Bros. for London millers.

[3] The time decreased from four to five or even six months to less than one month.

rainfall, and consequently we find it grown to the greatest advantage in that part of the plains of India where, at least during the winter months, the climatic conditions of the summer of Europe are most nearly approached. No definite limitations can be laid down as marking the borders of the wheat area in a south-eastern direction, as it does not abruptly end, but gradually shades off, as it were, as the conditions of climate and soil become less and less suitable.

The south-eastern boundary may be roughly delineated by drawing an arc of a circle, the centre of which is supposed to rest somewhat to the west of Lahore, so that it passes through Bombay in the south, and Dumraon, to the west of Patna, in the north. In the latter district may be supposed to rest the eastern gate of the wheat region, looking in the direction of Calcutta.

Sir Edward Buck, in speaking of the possible increased growth of wheat, divided this north-western wheat-growing region into three parts, indicating that in No. 1, which skirts the borders of the great desert of Rajputana in the North-West (shown on Map No. 1), the increase would of necessity be by extension of the cultivated area. In No. 2, which embraces Oudh and some of the densely populated parts of the North-West Provinces, if increase of wheat cultivation occurred, it would be by substituting it for other crops; and in No. 3, lying to the south of Nos. 1 and 2, and embracing the famous wheat lands of the Berars, increase might result both from substitution and extension.

I am aware that the crop returns of Oudh show within recent years an area diminished as regards wheat. This is at variance with information elicited on highly responsible native authority, which, however, it must be admitted, might be local, that wheat was being grown in place of the various pulse crops, maize, barley, and even, in some instances, rice. The pulse crops (as gram and peas) were being most extensively superseded.

This information might have been more recent than the Government returns, or the discrepancies might be accounted for by the last returns being made more accurately, and consequently in a form not suitable for comparison with older returns of an imperfect kind. It must be admitted that it is a most difficult task to properly estimate the relative amounts of the ingredients of a complicated mixed crop, such as is constantly to be met with in India.

The statistical abstract, 1887, shows from available returns a total area in round numbers of 19·8 millions of acres under wheat, and if we add about 1 million acres for Bengal, the grand total approaches to nearly 21 million acres,[1] made up as follows:—Punjab, $7\frac{1}{4}$ mil. ac.; N.-W. Provinces, 4 mil. ac.; Central Provinces, $3\frac{3}{4}$ mil. ac.; Bombay, $2\frac{1}{4}$ mil. ac.; Oudh, $1\frac{1}{2}$ mil. ac.; Bengal, 1 mil. ac.; Berar, $\frac{3}{4}$ mil. ac.; Madras, $\frac{1}{33}$ mil. ac.

Wheat is grown in India as a rabi crop, being sometimes broadcasted, but more frequently dropped through a bamboo tube fastened to the upright stilt of the native plough, or in Bombay sown by the regular seed drill. It is put into the ground about the same time as autumn wheat is sown in England—from the middle of October onwards, but not later than January, the early sown crop usually giving the best return. About the same amount of seed is required per acre—two bushels, more or less, depending on local conditions, which are well known to the cultivators. Little success attends efforts directed towards the alteration of the usually accepted amount of seed in a district. In the neighbourhood of the Khándesh Farm, 30 lbs. per acre was the quantity sown with the best results; and throughout Bombay, in dry crop cultivation, the amount rarely exceeds half a bushel.

The crop takes between five and six months to come to

[1] This is exclusive of Native States, which would raise the total to about 26 million acres.

maturity, and, unlike wheat in England, is harvested in spring or early summer, according to the time of sowing.

One reason for the failure of imported English wheat is doubtless the fact, that on account of its slower habit of growth, it is spoiled by the weather before coming to full ear.[1]

It would appear that about 7 or 8 bushels is an average return per acre where no manure is applied in the case of land that has been under cultivation for some time. Heavier crops are grown on newly broken-in soil, while the temporary fertility—the result of the vegetable accumulation which is made while land lies in a state of nature—is yet unexhausted.

In Northern India the crop is cut, but in some parts of Bombay it is pulled, so far accounting for earthy impurities in the samples of dressed grain.

Until 1873 there was an export duty on Indian wheat, and at that time only 1,750,000 cwts. were exported.

The review of the trade of India, by J. E. O'Conor, 1887, shows that the exports of wheat for the year "were the largest on record," amounting to 22,263,320 cwts., or about 1,113,000 tons. Nevertheless, the trade with the United Kingdom was nearly 20 per cent. less than in the previous year 1885-86. There was an enormous increase

[1] In some carefully conducted experiments with samples of various races of English wheat, carried out under the Director of Agriculture for Bombay, some germinated but failed to mature, others rotted without showing signs of vitality. In the latter case probably injury had been done during transit. It is a fact well known to those in the malting barley trade, that it is unsafe to ship foreign barley which has to pass through a hot region at certain seasons of the year, because it is not in condition, and the germinating power, of such vital importance, is often completely destroyed. Seeds of all kinds that have to be shipped to hot countries require to be carefully dried to insure safety. This is so important, that large Seed Firms who undertake foreign trade have made out by experiment a fixed critical temperature which they find to be the best suited for the drying of each description of seed. I have no doubt but that the reduced quantity of native moisture in Indian, as compared with English wheat, is a necessity for its safety in storing.

in exportation to Italy, amounting to about 200,000 tons. This was brought about by a deficiency in the crops of Southern Russia, which used to supply the Italian markets. The wheat trade with Italy is discouraged by a recently increased import duty, which now stands at Livres 30 per ton. Indian hard wheats contain a considerable percentage of gluten, which makes them suitable for this particular trade for two reasons:—(*a*) for the manufacture of macaroni, and (*b*) to increase the amount of albuminoids in the food of the poorer classes in districts where maize and inferior grains form the staple food.

The published figures for the last three statistical years are instructive as showing the marvellous development of Italy's wheat trade with India. In 1884-85 she imported in round numbers only 700,000 cwts., in 1885-86 it rose to 1·2 million cwts., and in 1886-87 to 5·2 million cwts. In the latter year the United Kingdom absorbed 9·6 million cwts., France 2·8 million cwts., Belgium 2·4 million cwts., and Egypt 1·3 million cwts.

Speaking broadly, the soft Indian wheats are those preferred in the English market and in Holland and Belgium, while in Southern Europe the hard types are in favour. For home consumption the native population of India prefer hard wheat, and until the export trade developed, the soft kinds, which are now in such demand for shipment, were at a considerable discount in the local markets.

I am indebted to my friend J. Nisbet, of Harris Bros. & Co., London, for the following facts in small print relating to Indian wheat:—

Hard Calcutta.—A clean, strong sort: goes much to Italy; also comes freely to the United Kingdom. Goes for mixing into No. 2 flours, and is most useful in the hands of millers who have adopted the new roller machinery. Grown in rice districts in lower Bengal.

Soft Red Calcutta.—A dirty wheat; wants much cleaning; varies 3s. to 4s. per quarter in quality. Has strength, and goes for No. 2 and No. 3 flour in the United Kingdom. Seldom goes to Italy, but to Holland and Belgium. Chiefly grown in Mid-Bengal.

No. 1 Club Calcutta.—Best soft, white wheat shipped there. Comes to the United Kingdom, Holland, and Belgium, not to Italy. Often too foul; sometimes too red. Goes into No. 1 flour, but does not easily keep on account of the attacks of weevil. Grown in North-West by Delhi, Cawnpur, and Meerut. *White Delhi.*—Handsome, soft, white wheat, longer and thinner in the berry than pure No. 1 Club. Has at times rather too much barley mixed with it, but is a favourite wheat with U. K. millers.

No. 2 Club Calcutta.—Same as above, only second-class wheat, but the sort of "consols" of the trade. Great favourite with United Kingdom millers. Holland and Belgium also take it very freely, but little goes to Italy. Often varies considerably, and could be sent much cleaner if shippers put pressure on native sellers.

Hard Red Bombay.[1]—Big red Talavera-shaped wheat. Goes to Italy; also comes here freely, and in some seasons goes into No. 2 and 3 flour. It is only used to best advantage in roller mills.

Soft Red Bombay.—A fine Talavera-shaped wheat, and when pure—which it generally is—is a great favourite for No. 1 flour. One of the best of the Indian wheats.

Atbara Red Bombay.—Not so good as above, shorter in berry, and harsher and coarser generally. Goes into No. 2 flour in the United Kingdom, and but little to Italy.

Hard White Bombay.—The best sorts are splendid, and go to Italy for macaroni, and we never see them here. The secondary sorts go to Italy also, but at the same time come to the United Kingdom when most wheats are 10s. per quarter over present rates.

Hard Yellow Bombay.—Very much the same remarks apply. Seldom seen here or in Holland and Belgium, but goes to Italy and Marseilles.

Soft No. 1 Bombay White.—Is the best wheat that comes to the United Kingdom, and is handsome, fine stuff. Goes into No. 1 flour here and in Holland and Belgium, and has begun to go to Italy for the best bread, not macaroni.

Secondary Soft Whites, Bombay.—Come to the United Kingdom, Holland, and Belgium. They are useful, but are not grand wheats, and are often too foul.

Soft Red Karachi.—Is a wheat that generally comes very freely to the United Kingdom, Holland, and Belgium, but, as a rule, does not go to Italy. It is very much used for No. 2 flours, but the great drawback is the quantity of barley in it.

[1] The name Bombay is given from the port of shipment. The wheat is grown largely in the Central Provinces.

To Soft White Karachi the latter remarks apply, except that this sort goes into No. 1 flours at times when extra good and extra clean.

Hard wheats are, as a rule, those supposed to contain a large percentage of gluten, but the hardness in Indian wheat seems to be more a matter of a reduced quantity of moisture rather than the presence of an excessive amount of flesh-formers. Though Indian wheat is not usually deficient in the quantity of gluten, this constituent from the baker's point of view is generally deficient in quality, and the dough in baking into bread wants tenacity. It will not adhere as dough ought to do in working, and Indian wheat in consequence is termed "weak."

It has another serious drawback in the eyes of bakers: it will not rise when the loaf is fired like good flour from other sources, and the loaf consequently looks unnaturally small and dense. These defects have practically excluded it from the markets of Scotland, where all classes consume the best quality of flour. It is astonishing to find that Indian wheats are not more extensively used in Ireland, where one would imagine the small cost would be a very important matter. England is the place of all parts of the United Kingdom where Indian wheat flour is in favour among the poorer classes, and where bread is baked at home. Its inferiority in swelling power is not there so much objected to, and the price is low considering the amount of food ingredients present. Though the gluten does not behave like ordinary gluten during manipulation, yet it does not follow that the gluten of Indian wheat is not so valuable as a food substance, and it should be remembered that though defective in the power of rising during the process of firing, yet the weight of bread yielded per sack of flour is decidedly above the average.

M'Dougall Brothers in 1882 carried out, at the request of Government, elaborate experiments in the milling and baking of four selected samples of Indian wheat—No. 1, fine soft white; No. 2, superior soft red; No. 3, average hard white; and No. 4, average hard red—contrasting these with well-known wheats from different sources.

The prominent features of the wheats were forcibly brought out and recorded in the report, dated from 10 Mark Lane, on 15th October 1882. The extreme dryness was noted, also the thin skins, the two qualities which stamp Indian wheats as being profitable for the baker and miller respectively. With the exception of No. 1, which contained about 6·5 per cent. of gluten, the samples showed an average amount of this most important constituent ranging from about 10 to 13·5 per cent. The dense condition of the bread baked solely of Indian flour is more dwelt upon than the so-called weakness which is exhibited in working the dough.

The report upon the whole is favourable, and shows such an amount of fairness in dealing with both good and bad qualities that it inspires confidence. In summing up it says:—"There is no possibility of Indian wheats coming into demand for manufacture into flour *without a liberal admixture* of other wheats." . . . "Their beany flavour is not a serious obstacle, as they can be employed in the proportion of 25 per cent. to 50 per cent. along with home-grown or other wheats, such as American, possessing a fine sweet, milky, or nutty flavour." They are pronounced to be "exceedingly useful wheats—their great dryness and soundness rendering them invaluable for mixing with English wheats that are in any degree out of condition."

Wheat Exports.—The matter connected with India interesting to farmers above all other matters is the influence which the wheat trade of India will have in future on the wheat trade of the United Kingdom. It has been thought by some that the future supplies of Indian wheat will so increase as to flood our markets to overflowing. I do not deny that Indian wheat will for many years remain a substantial item in our annual wheat imports, but there is no indication that the amount of it will increase at anything like an alarming rate. With the extension of railways new wheat-growing districts will be tapped, but the supply of easily available land is by no means unlimited.[1] **The drawbacks and disadvantages** are far more numerous than most people suppose. Dry crops are always liable to be ruined by drought. Fungoid diseases, such as *smut* and *rust*, diminish the crop. Rust affects most seriously wheat that is grown under irrigation—that small portion of the wheat area which is practically guaranteed against the influence of the over-dry climate. Early frosts do much damage, not only reducing the yield, but lowering the quality of grain, if indeed the crop is not destroyed. The wheat-growing districts of the North-West of India suffer most from frost.

When we add to the list of injuries enumerated that brought about by fogs, and at intervals by rats and locusts in the field, also by weevils during the periods of storing and transit, it will be admitted that the Indian wheat-grower does not possess immunity from the vexations that proverbially afflict the agriculturist. Again, in his efforts to extend the area of cultivation into new districts, the trials of the cultivator do not end here. Uninhabited districts are often like new houses, unseasoned for human habitation, and consequently unhealthy—in this instance liable to induce fever. This, along with the want of ambition and the clannish desire to remain at home, tends to unduly

[1] The following is an extract from a letter which Sir James Caird received from The Viceroy in April 1888, in answer to questions put to his Excellency regarding the great decline in the imports of wheat from India, especially in the latter half of the year 1887 and the early months of 1888 [only one-sixth of the imports which came during the corresponding periods of two preceding years arrived during the first two months of 1888],—"The decline of exports from India did not really commence till 1887–88. In 1886–87 an increase in the exports to Italy made up for the decrease to the home country. The real check in exports did not take place until July 1887, and has evidently been due to the short harvests of food grains in the preceding two years. The fluctuations in the stock of food grains in the country appear to have more influence than English quotations upon the price of wheat in India."

increase the density of population in some parts, and to restrict for the present the supply of Indian wheat for our home market.

We must not forget also the likelihood of the yield decreasing, and the quality degenerating by too frequent growth on the same land. I believe that the land is not seriously impoverished by the native systems of rotation, or by the practice which they have of growing mixed crops, but it will be strange if they alter these time-honoured customs, and grow wheat year after year with successful results as if the land were in the condition of virgin soil. Even now it is a pretty general opinion among natives, that wheat if not manured causes the soil to deteriorate if grown too often on the same ground. It has been the history of every great wheat-growing region, that the yield and quality came down if the soil was not kept up by manuring, as in this country. America is a typical example. The line bounding the best wheat area has steadily moved westward, and left as a record of its course the ruins of disused and deserted mills. Sir Donald Mackenzie Wallace, the author of "Russia," and now Private Secretary to the Viceroy of India, gave me an excellent illustration of the case in point. A district in Southern Russia was suddenly stricken with the wheat-growing mania; for a few years the yield, for size of grain, quality, and quantity, was simply marvellous. In a few more years the yield in every way became normal, and in yet a few more years the produce diminishing in every respect, it became impossible for wheat-growing to continue, and the people had to go back to their rye crops and other coarser grains.

If wheat is to continue to grow to advantage in India, it must be in a judiciously arranged rotation which embraces a number of leguminous crops, so that, in place of our markets being over-flooded with wheat, we may expect a substantial supply of wheat along with cattle food stuffs, such as gram, peas, and other pulses, which should prove an advantage to the farmer in the way of supplying cheap food for his stock.

These foods, however, are not to be adopted without caution. No less than two diseases in horses are attributable to gram. The one may be called Principal Williams's Manchester Horse Disease, a blood poison which I believe to be identical with the *anthrax* of India. The other is a nerve disease, described by Principal M'Call, of Glasgow, in which the tongue becomes paralyzed.

The impurities in Indian wheat when it arrives in this country have unquestionably kept down its price in the British market. The presence of such seeds as peas, gram, and barley is accounted for by wheat being grown as a mixed crop. Properly constructed cleaning machines can extract these and what remains of broken straw; but the most objectionable impurities—viz., lumps of hard clay, powdery earth, and small stones—though capable of being removed, are more difficult to get quit of.

Wheat Cleaning.—I am indebted to Dell & Son of London for the following particulars relating to their system of cleaning Indian wheat. It would appear that perhaps five-sixths of the Indian wheat used by the south country millers is cleaned without washing, as washing, in their opinion, though it improves the colour (whitens the flour), decreases the strength of Indian wheat, which, as we have already seen, is originally defective in this particular.

In the north of England, again, nearly all the Indian wheat used is washed, on account of strength not being there such an important market quality as colour. Hard wheats are so dry that it is necessary to supply moisture before grinding under any circumstances.

Wheat which has been properly washed and dried is improved in keeping quality; and, what is most interesting, a truly hard wheat, by the process of washing and drying described below, can be converted in every respect, including external appearance, fracture, and milling properties, into a soft wheat. This confirms my previously expressed opinion, that moisture has much to do with determining the hard or soft nature of the grain. What seems now to be of vital importance to the British wheat grower, with the increasing tendency towards the use of hard wheats by millers who employ the new roller mills, is a knowledge of how to reverse the process and convert soft wheats into hard wheats. I am afraid the difficulties in this are much greater than are to be found when the process is differently directed.

During cleaning wheat undergoes the following treatment. It passes through—

(1.) The warehouse separator, with adjustable sieves, to remove large impurities, and a fan running 500 revolutions per minute extracting the finer or lighter particles.

(2.) This is a double operation, that of washing and drying by the same machine (shown in Figure I.) The wheat is fed in by means of worm conveyors, and passed through the following parts of the machine in the order named:—(*a*) a cast-iron water tank, where the washing begins; (*b*) a settling chamber, where chaff and unsound matters are floated off; (*c*) a revolving perforated cylinder, placed at an angle partly in and partly out of the tank, as shown in Figure I. The upper part of the cylinder acts as a dripper. The wheat falls from the upper end of the cylinder, as indicated by the arrow to the right, and is elevated by a worm shoot into the centrifugal dryer or "whizzer," shown at the high left corner.

In another common variety of washing machine the water tank is dispensed with, and the descending stream of wheat is met by jets of water, so regulated in strength that the wheat is carried off with the water, and the stones, which are heavier, continue to descend, and are thus separated. This is said to be the most effectual method of removing stones, which are so common in Indian wheat.

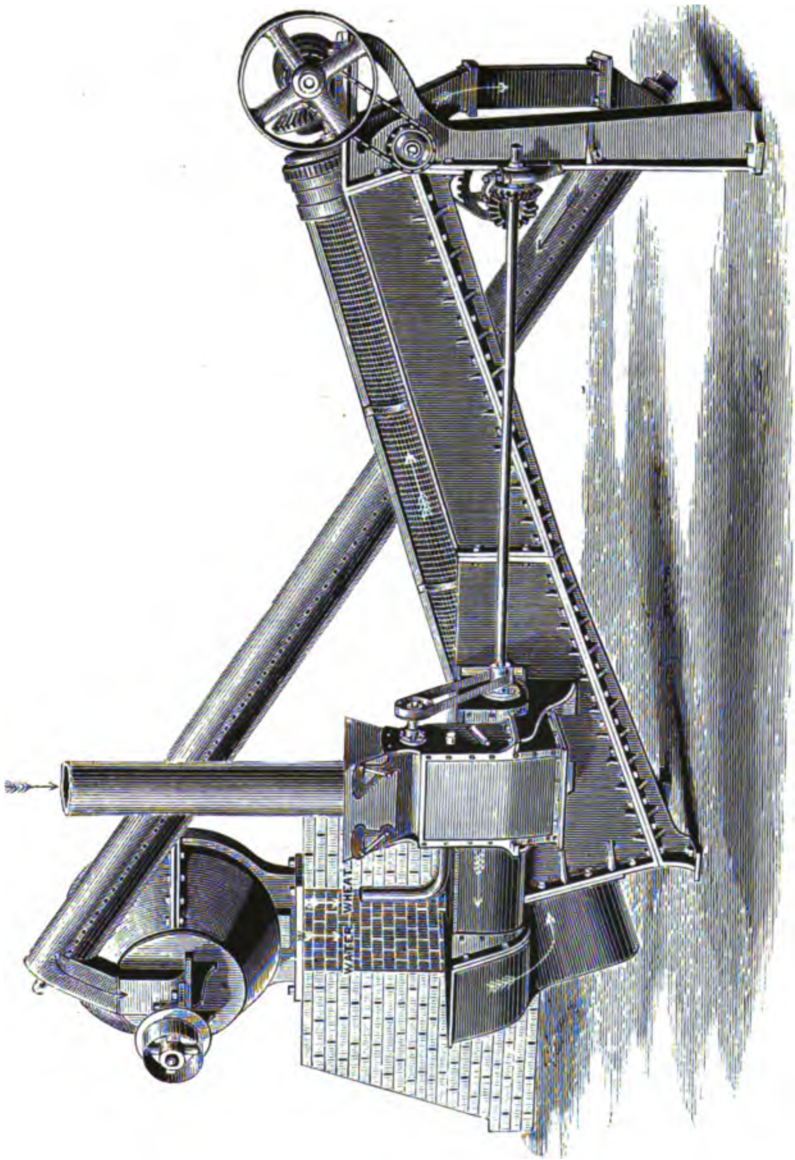


Fig. I.—*Wheat Washing and "Whizzing" Machine.*

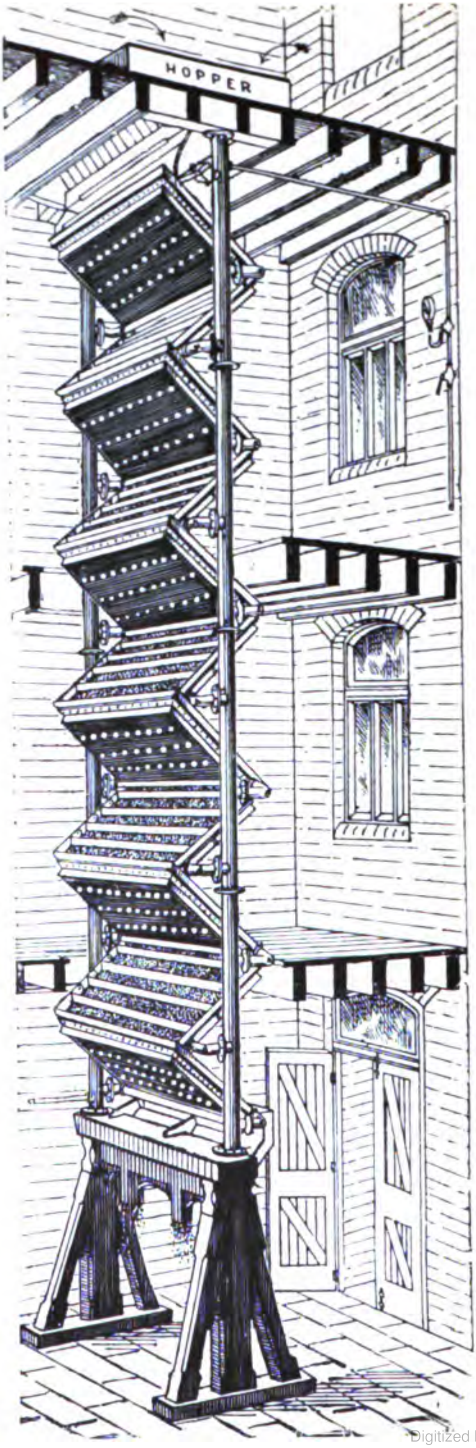


FIG. II.—*Automatic Grain Drier and Conditioner.*

(3.) The wheat is next dried and mellowed by being allowed to run down in a zig-zag course over the surfaces of steam jacketed plates. See Fig. II.

(4.) It is then removed to a "dickey" to cool before being passed through.

(5.) A wheat "separator," and oat and weed "extractor."

(6.) The "smutter," which does its work by rubbing or

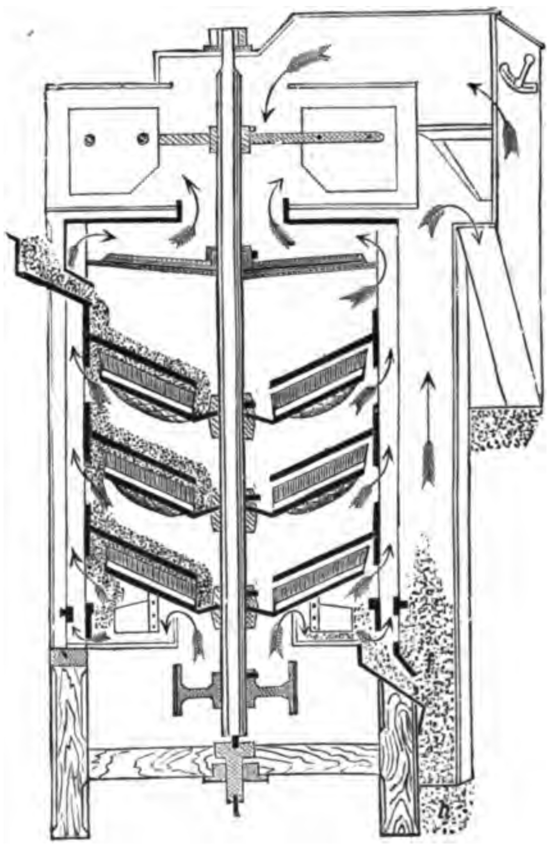


FIG. III.—*Double Brush Scourer and Polisher.*

friction; and finally, (7.) Through the "double brush scourer and polisher," seen in section in Fig. III.

Sources of Impurities.—The methods of temporarily storing wheat in pits in the ground until it can be sent off to market, also the practices of harvesting it by pulling (as carried out in Bombay) and of treading out by bullocks, make it almost impossible to get it absolutely free from earth; but, in addition to this, it has been the regular custom for the up-country local middlemen or dealers, and even for some large and influential exporters at the great shipping centres, to deliberately add 4 or 5 per cent. of dry earth to the bulk. **Five per cent. of refraction** (impurities), or even up to 7 per cent., had got to be an acknowledged standard, while in many cases the natural impurities of the earthy sort did not exceed 2 or 3 per cent. This has lowered the average price of Indian wheat very considerably; as there has had to be paid for, out of the wheat itself, the cost of adding the impurities, amounting to many thousands of tons annually, and the cost of handling and of carriage of the same from India. To this I do not add the cost of cleaning, because, in any case, it must be cleaned, and the expense demanded for the removal of 5 per cent. of dry mud is not much more than is necessary to clean away 2 per cent.

The system of adulteration has been a decided loss to the country, though it has been practised so as to secure an extra and unearned profit to one class of traders. It is necessary for those desiring a change in this matter to look to India, where the loss is being sustained, rather than to the English brokers or millers, who, although sympathetic, are not induced to take the initiative by prospects of pecuniary advantage. It would seem that something has recently been done by the Calcutta merchants to encourage the middlemen to bring forward their samples at least moderately clean.[1] The sooner the Indian chambers of

[1] A cablegram, dated 26th February 1888, says: "Up-country sellers will have a right as heretofore to deliver wheat containing 5 per cent. of foreign substances at contract price, or he may deliver 2 per cent. more, subject to an

commerce—in whose hands the key of the situation really lies—get to understand that it is for them to lead in this matter, not for the English dealers or consumers, the sooner will this difficulty in the Indian wheat trade be adjusted. They may in their efforts rely upon the support of all good traders in this country.

The cost of producing a quarter (496 lbs.) of wheat in the North-West Provinces and Oudh was calculated by the Government experts in 1887 to be 11s. 9d., and the total cost of landing wheat in London from Cawnpur, 31s. 11d., which includes the original price.[1] It is an extremely difficult matter to determine the cost of production, as those who work are not, as a rule, hired servants earning wages, but small cultivators the value of whose labour cannot be measured in terms of wages. **The work of growing wheat** for exportation may be looked at in another way: as the additional work of men who, if not employed in planting, weeding, or harvesting wheat, would be idle, having done sufficient work at other seasons and in connexion with other crops to supply in years of plenty all their limited requirements. Looked at from this point of view, which I do not pretend is suitable for all Indian wheat, **any gain, however small**, over and above the tear and wear of the working plant, which is extremely little in India, is profit. The margin of profit is thus practically extended to the whole price got by the ryot for the wheat (if the soil is not being injured), and accounts for the fact that wheat may continue to be sent to this country apparently at a loss to the cultivator so long as he can get anything whatever in addition to the cost of freight. I refer merely to years when there is no scarcity of food of other kinds. When this occurs, Indian

equivalent deduction from the price. But if the wheat contains over 7 per cent. of admixture he will be mulcted according to a fixed scale."

[1] When I returned in September 1887, the P. & O. Co. was carrying wheat from Bombay to London at 11s. 6d. per ton, and some companies accepted less than 10s. per ton. The average rate may be stated at about £1 per ton, though at times it may rise to 30s.

wheat will be turned in to make good the deficiency, and the export to this country will be checked for a time.

Wheat is now shipped from India in bags containing 2 cwts. each. It is proposed to reduce the cost of carriage by nearly 1s. 6d. per quarter, through sending it loose in bulk in place of in bags. I do not believe this would ultimately prove of advantage to the wheat trade. Wheat loaded in bulk is a dangerous cargo for shifting its position if the hold of the vessel is not divided by partitions, which are costly at first, as well as inconvenient for other cargo. A shipping bill, which will one day be passed, is morally certain to make loading in bulk illegal unless special and expensive precautions are taken on the plea of safety. This would necessitate a second change, with all its associated inconveniences and expenses, should bags now be discontinued.

CHAPTER XXII.—THE CURRENCY OR SILVER QUESTION.

Appreciation of Gold and Depreciation of Silver—Mistakes Relating to a 25 Per Cent. Profit or Bounty on Indian Wheat—Object and Influence of a Bounty—Influence of Railways on the Wheat Trade—O'Conor's Reports on Wheat—Position of the Indian Wheat Cultivator—Tendency towards Higher Prices in India—Injurious Results of Unsound Trade—Why European Merchants Oppose Bi-metallism—Necessity of Bi-metallism on Public Grounds—Increased Stability Offered in Bi-metallism—Influence of Present Conditions of Currency on the Growth of Trade—Influence of Exchange on Pensions.

THE **influence** upon the wheat trade of India of the recent alteration in Europe **of the relative values of gold and silver** has been more warmly discussed than any other question concerning our Eastern Empire. For the sake of convenience, and merely by way of illustration, I shall assume that the relative value of gold as compared with silver has increased 25 per cent. Let it be distinctly understood that it is gold which has appreciated, not silver which has depreciated, because to fully recognise this will remove the stumbling-block over which so many have fallen. It is quite true that if one speaks of the relative values of gold and silver apart from everything else in the way of values, it may be admitted that a rise in the value of gold is synonymous with a fall in the price of silver; but it is the values of trade commodities relative to these varying standards which should in this instance determine the matter and show wherein the difference lies. By appreciation of gold, we mean the rise in the value of gold as compared with silver, wheat, and other commodities; by depreciation of silver is meant the fall in value of silver as compared with gold, wheat, and other commodities. A condition which would form an exception to this rule is within the range of possibility. For example, it might be possible for silver and ordinary market commodities to simultaneously rise in price from different causes. In the case of silver, rise might be due to its appreciation as compared with gold, while the rise in the price of other staple commodities might be the result of trade influences which had nothing to do with questions of currency. Though possible, this combination of circumstances is most unlikely to occur, and everything seems to point to its absence in the case before us.

It has been loudly and persistently stated at random, and with little regard to the actual facts of the case, that *the variation in the values of gold and silver has been equivalent to a profit erroneously termed a bounty of 25 per cent. on Indian wheat, and that the currency influence has been the one of greatest importance* in the development of the wheat export trade from India. I hope to be able to show that neither proposition is at all consistent with the facts of the case, although in the development of the trade there have been slight tendencies in the directions indicated.

That a minor influence, equivalent in some respects to a **bounty**, has existed and does exist I will not deny, but it must take quite a subordinate position. Again, as affecting the growth of the wheat trade, I place the importance of the influence of the opening up of the country by railways, and thereby making a direct connexion with a very superior market, immeasurably before the effects of currency. It might even be asserted that the changes in the currency have been hurtful, and that had trade in Great Britain been good through immunity from the evil influences of an alteration in value of our gold standard, more wheat would have been required for consumption and higher prices paid for it. This would hold good if the additional demand did not induce other countries to send an additional supply, which would bring down the price. India, in any case, as the country capable of producing wheat to pay at a smaller cost than any other country, has nothing to fear in this for the volume of her trade, because in other countries the one incentive to the growth of wheat —viz., the margin of profit—must disappear before *her* margin of profit is exhausted.

In dealing with the two distinct divisions of the subject, it is necessary, in the first instance, to lay down **broad and unmistakable economic principles,** and to apply them to the facts before us. Many of the wrong conclusions that have been come to have been derived from an attempt to take what appeared to be a common-sense view, from a superficial study of the points at issue, to the neglect of the fundamental principles of the question.

The great object for which a bounty is given is the transfer of the trade or a portion of it from the home country to the new or bounty receiving country. In my opinion too little value has been attached by popular exponents of political economy to the importance of the transfer of a trade in this way from one centre to another, the very minor and side issues of the balance of profit to the producer having usually been taken as of first importance. The question of transfer also practically involves, as regards the profit or loss to the country, the whole of the wages given to the workmen employed. In olden times, when it was possible to turn to another industry when efforts in a certain direction became unremunerative, the case was different; but now, when over-production exists on all hands, the stoppage of one branch of industry results in its employés going to swell the ranks of the unemployed. If some of the best men do find room in other branches of trade it is by ousting inferior hands, so that the final result as stated is the same; or, to look at it in yet another way, if they do find employment, they exert a direct influence in lowering wages all round by increasing the supply of labour while the demand has not increased.

It is not at all necessary that the producer receiving a bounty should make an extra profit for himself out of it. The bounty may at first be all absorbed in meeting the extra outlay in establishing a new business, and in making good the unavoidable loss from inexperience, and yet accomplish its object. The bounty having been so far successful would increase the supply of the commodity, whatever it might be, and the increase in supply being entirely artificial, not brought about nor called for by a corresponding increase in demand, would tend to lower the average prices in this branch of trade. As the profits naturally decrease, a saving through the increase of experience is effected by those belonging to the bounty supported part of the industry, and if the bounty is sufficient, they retain their profit and maintain their existence, while those connected with the original undertakings of the same sort in other regions not receiving bounty are all more or less starved out, and some—the ones least favourably circumstanced—have actually to discontinue work altogether, the whole margin of profit having disappeared.

The railway system of India may be looked upon as in some respects equivalent to a bounty, being the means by which the ryot is enabled to place his grain in competition with the wheat of the western world. The perfectly natural result of this is that prices in the central market—the United Kingdom—have been lowered, and not only have the average profits at home been reduced, but many of those who were originally growing wheat at a small profit have had this absorbed, and have had to lay their land out to grass and largely decrease the annual sum paid for labour. No such profit as 25 per cent. is required to produce this result, and no such profit exists.

The 25 per cent. exceptional profit theory breaks down because silver, which is the standard of exchange in India, has fallen along with wheat, and in transactions between the two countries the terms of currency have first to be adjusted; gold must be translated into silver and *vice versa*.

J. E. O'Conor has shown that wheat, in common with other commodities in India, has within recent years risen in price, which may be taken as an equivalent to saying that silver, when compared with commodities, has become less valuable. This rise in the value of wheat in India, while at the same time a fall in value is taking place in England, may be looked upon in one sense as a direct detriment to the development of the wheat trade by lessening the margin of profit to the middlemen, those most interested in pushing the trade. The influences at work in developing it have, nevertheless, been great enough to overcome this and all other drawbacks.

I fix the rise in price, approximately, by way of illustration in accordance with blue-book evidence, at about 7 per cent. No doubt this is so far brought about by sympathy with the influences that have been at work in Europe.

The cheapness of European silver must set more of it at liberty to go to India; but it would seem, from O'Conor's last reports, that since 1873, the time when the divergences in the values of gold and silver became marked, she has not yet taken full advantage of the turn of the bullion market in her favour, but has probably supplied the growing demand for an increase in the volume of the currency by relieving more and more of the locked up silver from the hoards that it has been understood were, previous to this time, accumulating. But there is another circumstance which would act as effectually, within limits, in reducing the price of silver. The ease and rapidity with which it is transported by rail is, as regards the currency, equivalent to an increase in its volume, and may go so far to explain why the amount of silver coined in India is less, on an average, within the last fifteen years than formerly. Again, an equivalent action is induced by the knowledge of the fact that silver, if wanted, could be brought at short notice to any given place. While the change in this direction is taking place a stimulus is unquestionably given to trade. In this matter, when silver becomes less valuable, when more of it can be got for certain staple commodities, it acts in the same way as a debased currency,—it increases the margin of profit for a time until all surrounding items of expenditure become adjusted to the new conditions.

The Indian cultivator has had, in virtue of the above facts, the advantage of a market tending to a rise in the matter of prices, and he has enjoyed a prosperity in consequence very much akin to the prosperity of the British farmer a few years ago, when he possessed a similar advantage. The fact that the Indian cultivator is very frequently his own labourer, doing the work of raising the crops himself, exempts him from the loss which would in other circumstances occur from the decrease in the value of his currency, as he has no servant to ask him for an increase of pay. He, in the first instance, reaps the advantage which naturally falls to the cultivator, and in the fulness of time, when a share at least of this should naturally pass on to a servant, he still retains it.

I have considered the effects upon India of a **tendency** in the currency towards a slightly **higher level** of prices, or, in other words, speaking of a currency which embraces but one ultimate medium of exchange, as tending to the decrease in value of this medium. I have shown that for the moment the advantage appears to be decidedly in favour of India; but I must now examine at what cost this apparent advantage has been purchased, and see if India is not trifling with her true interests by idly basking in this short-lived sunshine which precedes the coming storm, in place of looking for a convenient and suitable shelter in which to find safety. It is necessary in pursuing our investigation to be guided by precedent, and to judge of what is likely to come by a careful study of the relations of cause and effect.

We have seen that the tendency in India for some years has been towards **higher prices**, and we have touched upon causes at work which possessed influences in this direction. In so far as prices have been influenced by the change in value of the medium of currency, the resulting conditions are unnatural to healthy trade, and the situation is leading up to commercial difficulties in the future.

In the early years of the last decade Europe was passing through a similar stage of her commercial life. The causes of prosperity were to a large extent identical; prices gradually rose because the tendency in the medium of currency was to become depreciated. A tendency of this kind must have a limit. We have reached it, and have turned in the opposite direction. India seems to be approaching that limit, and will also have to retrace her steps.

It is most necessary to discriminate between a rise in prices due to general prosperity of trade when the guarantee of security is present in the form of a stable medium of exchange,—a permanent something to which every one can look among all the ups and downs of market prices,—as compared with that **shadowy so-called "temporary prosperity,"** that system of unwittingly living upon capital, which accompanies the depreciation of a currency.

I do not think that the injury resulting from hollow prosperity such as has been indicated is estimated at its full value, the demoralization of individuals and of a nation by their being permitted to spend a supposed income, which, if they do possess it, they got by accident and without earning it, and which after a brief space of time is to be suddenly discontinued. This is quite a different matter from the ruin of one or more even important classes in a community while the others are not involved. This might occur, causing much personal suffering to the individuals implicated, but without doing serious injury to the nation.

The Indian ryot is gradually becoming more extravagant; he has more money to spend, and he spends it. When in a few years the tendency in the alteration of his currency is reversed, for it goes without saying that a tendency of this kind in a matter of currency cannot go on in the same direction for ever, one of two things will happen—either the ryot will become a votary of frugality, which he has never practised, and of which he is totally ignorant, or else he will plunge more hopelessly than ever into debt. If contracts were all confined to the present, and future effects could be ignored, a change in the standard value of the currency medium would have no very serious consequences for the moment further than that produced by uncertainty, and trade would quickly adjust itself to suit the currency; but in this country many contracts extend into future years, and therein lies the difficulty. In India the ryot has two most important contracts which extend into the future—that relating to the rent he pays for his land, and that relating to his indebtedness to the money-lender. His engagements at present are about as heavy as he can bear; with additional burdens he must become bankrupt.

It is to the interests of European traders to contend that our present policy is better for India than an alteration to bi-metallism. As regards trade profits, no doubt, for the moment it is, but this is a very different consideration from what is best for the country. The position of India is very much like that of a great co-operative company,—let us say, the Oriental Bank, or the City of Glasgow Bank, the directors of which continue to pay a slightly increasing annual dividend, which is taken as a sign of prosperity, and which pleases the shareholders for the moment, but all the while the capital of the concern is melting away. It will at once be admitted that the enlarging dividend has many charms, and, besides, confers a substantial advantage upon the shareholder who sells out and retires from the undertaking before the crisis comes; but where is the man who will say that on the whole the increasing dividend was an advantage to the body politic when it was reaped at a sacrifice of capital?

Nothing but an unexpected and almost impossible increase in the world's **supply of gold,** or the adoption by the leading nations in Europe of the system of **bi-metallic** currency, will save the Indian Government from the increasing currency difficulties in which it is already seriously involved. I do not for a moment suppose, in the event of bi-metallism being adopted, that appreciably more gold than at present would be required in India. Silver would remain, as it is now, the universal currency medium.

The benefit would result from the increased stability in what would then be equivalent, in the commercial world, to a common standard measure in currency matters. The ratio between the metals of the joint standard would remain absolutely the same. I do not deny that there might be fluctuations in the value of this, our adopted medium of exchange, because the laws which now govern all currency matters would remain practically the same. The change would not affect the magnitude of the forces at work in currency questions, it would merely make the objects against which these forces are directed less easily affected. With a balance established between gold and silver, such as that which existed in the days of the Latin Union and bi-metallic France, an additional inertia, as regards fluctuation in value (that evil which has worked so much of the mischief), would be given to the combined metallic medium. The difference may be considered to resemble the difference experienced in moving a body weighing a ton as compared with one weighing 1 cwt. The tendency to change under present circumstances would presumably be towards a slight appreciation in value.

The bi-metallic remedy was at first doubted both in this country and in India, but there are two significant facts regarding it—(1), That those who were most intolerant of it are now compelled by the force of circumstances to give its supporters a hearing; and (2), The ranks of its advocates are being steadily filled from the thinking world with men of undoubted reputation and earnestness of purpose.

Influence of exchange on Pensions.—By way of illustrating the indirect injury to the interests of the country from the currency having been allowed to drift into the unsatisfactory condition above indicated, I may mention the natural discontent of members of the Uncovenanted Civil Service, who look forward to their retiring pensions being paid in terms of Rs., the standard of the degenerate currency, and not in terms of gold. This means a loss to them of some 33 per cent.[1] on the exchange, which is implied, as retiring pensions as a whole may be looked upon as spent at home. But the serious consideration from a national point of view is the substitution in certain of our public services of the work of officers who are contented, and whose minds are consequently capable of being exercised to the best advantage, for the work of men who have their minds distracted and their faculties unwittingly impaired by a real and serious grievance, which involves the lowering of the status of the whole branch of the service through the imperfect education of their families, and through their inability to retire into a condition of competency in their old age. I put it to all practical men who are conversant with the details of the employment of others in any capacity, when a real grievance springs up, which is not of the seeking and out of the reach of the influence of the employés, if it is not the best, or, in fact, the only way to secure efficiency,

[1] Theoretically, no doubt, the prices of goods in this country should have fallen an equivalent amount, but, practically, this is not so in the case of fees for education or the retail trade in household commodities. The rise and fall of prices is quoted from wholesale transactions, which necessarily adjust themselves much more quickly to altered values than those in the retail trade.

to use the available means for its redress, apart altogether from the question as to whether a legal right is involved in the requests of those who are discontented?

The influence of the present unbridled tendency to a rise in value in the gold currency medium produces stagnation of trade or checks its development. The insecurity of investments in India practically excludes British capital. Much money is free for investment in this country and in America at a small rate of interest, yet in India a borrower has to pay 7 or 8 per cent. per annum.[1] It is needless to enlarge upon the check which such a rate puts upon youthful trade enterprises of all descriptions.

[1] This refers to ordinary trade transactions. When a ryot borrows from a money-lender the rate of interest promised is often quite exorbitant.

CHAPTER XXIII.—GRASSES AND GRASS LAND.

Indian Grasses different from European Grasses—Duthie's Books—De Laune's Paper—The Natives' Power of Observation—Help given to the Author by Coldstream, Wingate, and Meagher—Numbers of Grasses—Names, Descriptions, and Characters of Prominent Indian Grasses—Experiments on the Culture of Grass Land—Allahabad Grass Farm—Objections to Indiscriminate Grass-Cutting—Cutting by Hand—Mowing Machines—Quality of Hay—Silage—Johnson's Ensilage Stack Press—Silage Made in Pits and its Objections—Successful Results of Siloes in India—Sir Herbert Macpherson—Farming by Military Officers Unpopular and Unsatisfactory—Prospects of Ensilage in India.

INDIAN grasses are quite different from European grasses. The latter do not grow on the plains, although some do mature on the hills, as at Simla and Dárjíling.[1] To one who knows the home grasses, the difference of the composition of the green sward in India is one of the most striking features of the country.

The study of the subject of the grazing and other values of grasses in India is only in its infancy. In 1886, Duthie published *Illustrations of the Indigenous Fodder Grasses of the Plains of North-Western India*, and in 1888 a valuable description of them. From the former, by the author's permission, I copy the grasses which I have represented.[2] Some of the officers who have been connected with the grass farms under Government, particularly in Northern India, have acquired a considerable amount of

[1] I noticed that *Poa annua*, *Holcus lanatus*, and *Agrostis alba* had found their way to Dárjíling.

[2] Plate LXXI. is an exception: the original was drawn from nature by W. G. Smith, author of *Diseases of Farm and Garden Crops*.

practical knowledge of the merits of a number of the best grasses, but there has been no systematic effort on the part of Europeans to study the characters of grasses and the best means of propagating those of good quality. This is not to be wondered at, when we consider that scientific interest in the management of permanent pasture only began in this country in 1882, when Faunce de Laune published his now famous paper in the *Journal of the Royal Agricultural Society of England.*

The natives of India have great powers of observation for ordinary everyday objects. They possess a very extensive acquaintance with all common plants and animals. An ordinary ryot will recognise and name nearly every plant that can be picked up on his land, and with a characteristic sway of his head will indicate whether it is valuable or otherwise. The total ignorance of a countryman at home, in all matters of detail relating to the minor facts of Nature, stands out in striking contrast to the intimate knowledge of, and interest shown by natives in everything which immediately surrounds the human species in India. In mentally answering to myself the great and important question, Is the labouring population of India, when free from the ravages and horrors of famine, contented and happy?—I could not help contrasting the results of our modern European civilisation with the guileless plan so well exhibited in India, by which Nature occupies and develops the minds of her votaries, in a light which was decidedly favourable to her methods of working.

I am indebted to Commissioner W. Coldstream, Captain Wingate, and Sergeant Meagher for materially aiding me in my study of the grasses.

Coldstream permitted me to make notes from the materials he had collected with the view of publishing a work on Indian Grasses, now in the press.[1] I have used

[1] *The Grasses of the Southern Punjab*, by W. Coldstream, B.A. Edin., of the Bengal Civil Service. T. & A. Constable, Edinburgh.

a few of the facts he records in describing the grasses hereafter mentioned. Sergeant Meagher made me a valuable collection of the best grasses growing on the Allahabad Grass Farm.

In the plains of Northern India there are twenty-five or more really good and valuable grasses which enter into the composition of natural pastures.[1] The following are only a few typical specimens arranged in no particular order as regards merit, but the Plates will give an idea of the form and character of a few of the best varieties of the grasses.[2]

(1.) **Plate LIX.**—*Pennisetum conchroides*, Rich.; vern. Dháman, Anjan. The flower-head is intermediate in appearance between that of *Trisetum flavescens* and *Cynosurus cristatus*. This is one of the very best grasses, both as green fodder and as hay. In the latter form it is most suitable for horses. It is said, owing to its nutritious qualities, to be as much esteemed as clover is in this country. So much is it appreciated that there is a native saying, "What Ghi is to a man so is Dháman to a horse." For hay, it is cultivated as a rain crop. It is found growing on black loam soils, and generally along with *Andropogon Bladhii* and *pertusus*.

(2.) **Plate LX.**—*Panicum sanguinale*, Linn., or vern. Bara, Takri, Sŭrí, is good for both green forage and hay, but is not abundant, except on some rich soils. If it were possible to cultivate it largely, it would rival dŭb in the matter of quality and usefulness. Natives assert that it is superior to dúb, bulk for bulk. The flowering stem terminates with five to seven long spikes, all converging to a common point. Wingate says that "its rootiness interferes with its cultivation on an extensive scale, but it makes fine sweet hay."

[1] Sergeant Meagher speaks of 48 grasses being represented on the Allahabad Grass Farm. Some of these are not good, but he adds: "There is not a single grass which bullocks will not eat if siloed."

[2] Wingate mentions Nos. 1, 2, 3, 8, 10, and 13 as being, perhaps, the six best fodder grasses of Northern India.

(3.) **Plate LXI.**—*Andropogon pertusus*, Willd.; vern., Palwa, Jargí. The head consists of a bunch of soft spikes. This grass affords abundance of the best of green fodder for horses and grazing for buffaloes. It is all the sweeter if grown on rich soil. *Andropogon Bladhii*, Retz., vern. Janewáh, etc., is very like *pertusus* in appearance. It is equally valuable as a fodder grass or when made into hay in good time. They are both large-growthed grasses, and come to their best early in the season. They occupy a position in the first rank of grasses suitable for making hay.

(4.) **Plate LXII.**—*Andropogon laniger*, Desf.; vern., Bûr, Músel. A large coarse grass like the Brome grasses in this country—good while young, and valuable in bad years when in stack. For hay it should be cut early. There is a white and also a red variety, giving a tinge to the ground. It suits black loam soils.

(5.) **Plate LXIII.**—*Andropogon muricatus*, Retz.; vern., Panni. This is a large coarse grass, which grows in tufts in such localities as the temporarily dried bed of a stream. It is used for thatching, but it also affords grazing while young. Its roots are scented, and are plaited into the so-called "Khas Khas tatties," which are placed in windows of railway carriages and at the doors of houses, and kept wet for the purpose of inducing evaporation, and thereby cooling the air as it passes inwards.

(6.) **Plate LXIV.**—*Sporobolus orientalis*, Kunth.; vern., Kheo, Usar ki ghás, Palanji. The flower-heads are fine, like the *Agrostis*. It is well suited to horses both as grass and as hay.

(7.) **Plate LXV.**—*Iseilema laxum*, Hack.; vern., Grāndi. A large and fragrant grass growing in good land swamps, and much eaten by buffaloes.

(8.) **Plate LXVI.**—Spear Grass, *Heteropogon contortus*, R. & S.; vern., Lapha, Sárwála, Lamb, Purbáh. In appearance it resembles the slender Brome grass of Europe. It is a jungle grass common on damp land, and noted for its nourishing properties.[1] As it approaches maturity, the awns become hard, and if given to horses, pierce into and injure their mouths. Cattle do not suffer to the same extent. When green, the fodder is of the very best quality, and the bulk of the crop is large (about the largest of all the grasses), growing during the rains to a height of 4 feet.

The awns get united into bunches as the crop ripens, and are broken off by hand as it is cut. This is done at a stage which, under other circumstances, would be considered too late to harvest grass to secure the best results.

(9.) **Plate LXVII.**—*Elionurus hirsutus*, Munro; vern., Sin, Síwan, Sain, Rasaurá. A very tall (8 feet) coarse growing grass used for thatching, but also eaten when young. The flower-heads are woolly and soft.

(10.) **Plate LXVIII.**—*Eleusine ægyptiaca*, Pers.; vern., Kharmakrá, Makra, Madhána. This is a very nutritious, broad-leaved, succulent, soft grass with terminal clusters of short stout flowering spikes. The seeds are rubbed out, and used as food by the poor. As fodder for either horses or cattle, it is considered to rank with dúb. It is one of the earlier grasses, and past its best before the end of the season. It is generally short in growth, though it at times reaches 2 feet high.

(11.) **Plate LXIX.**—*Eleusine flagellifera*, Nees.; vern., Ghantil, Chhimbhar. This is a good grass, both as hay and pasture, and very plentiful. Donkeys are specially fond of it.

(12.) **Kánsá**, *Imperata arundinacea*, Cyrill, is a strong-growing, coarse-looking grass which I picked up on the bund[2] of Macpherson Lake, Allahabad. It is marvellously sweet and succulent while young, being in reality a small sugar-cane. It springs very quickly after the first crop is cut. Horses are specially fond of the flower-heads, which

[1] Wingate says, "It has deservedly made famous the rich pastures of Bundalkhand.'

[2] In this instance a heavy embankment.

Plate 59

PENNISETUM CONCHROIDES, Rich.

Plate 60.

PANICUM SANGUINALE, LINN.

Plate 61

ANDROPOGON PERTUSUS, Willd.

Plate 62.

ANDROPOGON LANIGER, Desf.

Plate 63

ANDROPOGON MURICATUS, Retz.

SPOROBOLUS ORIENTALIS, KUNTH

ISEILEMA LAXUM. HACK.

Plate 65.

ISEILEMA LAXUM. HACK

Plate 66

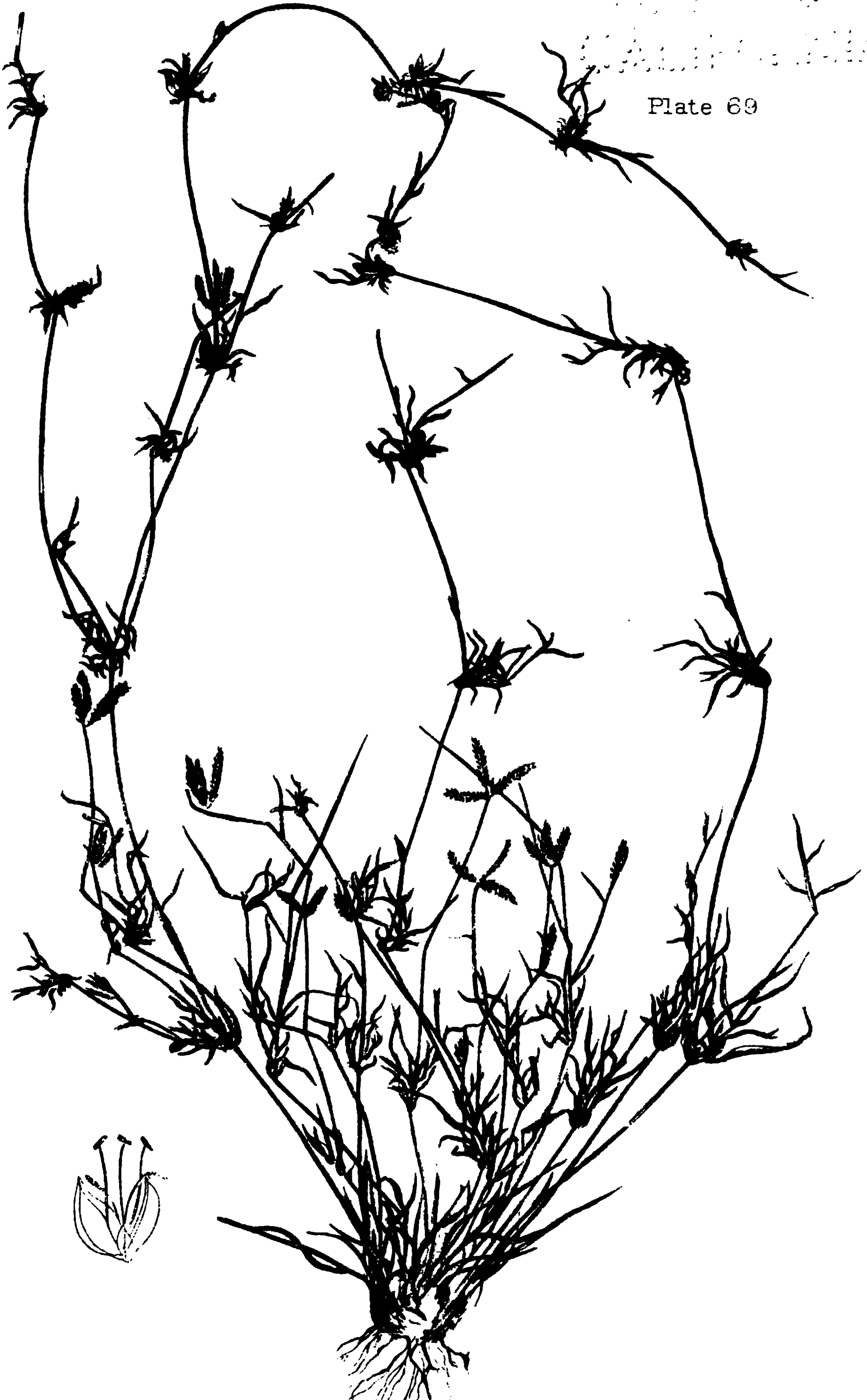
HETEROPOGON CONTORTUS. R & S.

Plate 67

ELIONURUS HIRSUTUS. MUNRO

Plate 68.

ELEUSINE ÆGYPTIACA. Pers.



ELEUSINE FLAGELLIFERA, NEES.

come about September. On account of its coarse appearance and hardness as it approaches maturity, it is usually neglected by European residents, although held in high favour by natives, and I believe deservedly so. In arable land it is an objectionable and troublesome weed. In this connexion it is associated in the neighbourhood of Allahabad with a strong-growthed inferior grass called Kúsá, *Eragrostis cynosuroides*, Retz., which, under ordinary circumstances, is only eaten very early in the season. The latter flowers in May. When made into silage it is given to buffaloes.

(13.) **Letanawáh Janewáh** is one of the very best grasses. All animals are fond of it and thrive on it. Its stems sometimes extend along the surface for a distance of 15 feet. Its most valuable property lies in its sweetness during the rains at the season when dúb is bitter.

(14.) **Tímpatiá**, *Dismodium trifolium*, D. C., is an excellent weedy plant possessing good fattening properties. It strongly resembles white clover, and might easily be mistaken for it, except for the flower, which is single, pea-like, and of a red colour. It is devoured greedily by all herbivorous animals, especially horned cattle. It assists in forming a close or thick sward on lawns and on grass land, where it occupies the place of white clover, which is absent. It runs along the ground, and only grows about 4 inches high. It is best cut with the grass and made into hay.

(15.) **Plate LXX.—Dúb Grass, Huriali, Khabbal,** or **Talla,** *Cynodon dactylon*, Pers., is perhaps the most widely distributed grass in India.[1] In this respect it corresponds to the *Poa annua* in Europe. It is at the same time one of the most objectionable and persistent weeds of light, cultivated land, and one of the most valuable green forage

[1] Wingate says, "At an elevation of 3000 feet it becomes scarce, and is rarely met with growing indigenously above 4000 feet, though it may be seen at even 7000 feet."

plants. It is generally a grass of small growth, though I have seen it grow up to nearly 2 feet in height with heavy dressings of manure. It has a wonderful power of remaining green, being *the* grass of all Indian grasses which retains its succulence throughout the extreme heat of summer. It is greatly appreciated by those in charge of horses. In the cold weather its growth is completely suspended, and it is now known that a number of more bulky grasses afford quite as good fodder, and more abundantly during the monsoon. It spreads by throwing out creeping stems, which bud and root at the nodes. These are grubbed up for fodder from all sorts of waste lands by a small iron spud or trowel, *kurpa*, which is made to pass through the soil about an inch or less below the surface. The early part of the season before the June rains come is the time when this produce, which is partly grown on the surface and partly below it, is most valuable owing to the scarcity of green fodder from other sources. The operation of skimming the land is the best method of cultivating a good sward of this grass, and establishing it evenly. Dúb, on account of its fine habit of growth, is a favourite on tennis lawns, which require to be spudded over at least once in two years, else the plant becomes weak and irregular or patchy. It is extremely difficult to clean out of cultivated land in virtue of the character of its stems; each minute joint left becomes a plant, consequently it is impossible to get rid of it entirely by hand picking. It is usual to feed the cattle at work in clearing land of dûb on the weeds that are collected and removed. As a pasture grass it is the better for a certain amount of shade, either afforded by trees or by larger grasses growing with it. It is at times planted by chopping the roots and spreading the fragments over the surface, and then ploughing to cover them; but this method of propagation is not always thoroughly satisfactory. At Allahabad it is most successfully cultivated, where it springs up naturally without any

Plate 70

CYNODON DACTYLON Pers.

Dúb.

Plate 71.

SPODIOPOGON PILOSUM, NEES.

Kunda

attempt to sow or plant it. The land is simply ploughed and manured. Dúb in a diminutive and valueless form is to be seen in Southern England growing on sandy places by the sea.[1] The valuable qualities of this grass in India, and its worthlessness in England when grown under different conditions, forms a parallel to the case of Kentucky blue grass, *Poa pratensis*, which in its home quarters, grown on the marls of the Silurian formation, is excellent, but in England it is an objectionable weed.

From this fact we may derive the valuable lesson which is of service in dealing with India, that because crops are known to thrive in certain countries, we are not to take it for granted that they will grow and do well in India.

(16.) **Plate LXXI.—Kúnda,** *Spodiopogon pilosum*, Nees., is a widely distributed grass with deep roots and underground stems, which constitute it the most objectionable weed of agricultural land in India. Throughout the black soil country it is seen studding the fields in patches which tend to enlarge. Ants, which abound in number and variety, are said to extend the area of growth of this weedy grass by collecting the seeds grown on the banks and waste places, and storing them in their houses made in the cultivated land. The seeds in an ant nest in due time naturally germinate and form a nucleus from which a patch may extend. The foliage above ground is hard and worthless, but the underground stems, if dug up while young and fresh, are said to form sweet and useful fodder. My own opinion of them does not confirm the latter statement. When mature, they are woody and like so many willow roots. Hand hoeing of patches is performed by careful cultivators turning up the roots near the surface to the action of the sun before rain comes. Deep ploughing

[1] Bentham's *British Flora* says, "In cultivated and waste places, especially near the sea, very common in Southern Europe, and in all hot countries, extending more sparingly into Northern France and Central Germany. In Britain, only in a few stations on the south-western coast of England."

is practised to keep down the growth, but I believe there is no mechanical means of thoroughly destroying it except by trenching to the depth of two spadings, hammering down the lumps, and carefully hand-picking the soil at a cost of Rs. 20 to Rs. 25 per acre. It is proposed in future to make this a famine relief work in certain districts. So far as I can see, I believe the effort will be fully rewarded through the increased cropping value of the soil. Kúnda is also destroyed by leaving the soil fallow for a time, which may vary according to circumstances from five to twelve years. Like *Triticum repens*, the objectionable couch grass of many cultivated soils in England, it does not thrive in land left out of cultivation, and gradually weakens and disappears.

I have pointed out, in the chapter on Forestry, the importance of cultivating grass and trees together. There is certainly wide scope for the development of both, if the efforts were well and intelligently directed.

If grass were cultivated at military stations, a knowledge of the proper methods of working would gradually spread throughout the country. When old soldiers go back and settle in their native villages, they often grow Lucerne[1] (*Medicago sativa*) to feed their cattle. My information relates to the Punjab, and it indicates what improvement can be worked by showing a good example in a matter within the slender means of the native population.

The experiments on the cultivation of grass land, which have been carried out on the Government grass farms at Allahabad and Cawnpur, have shown that wonderful results

[1] Colonel Pitcher informed me that the South American Alfalfa is Lucerne. In India much water is given during its growth. In America it requires little, and in England it became quite famous during the hot dry summer of 1887 for its power of resisting drought. This and its many other good qualities single it out as a forage plant which will grow in favour in India. Though guinea grass is the great fodder grass of Jamaica, it is not so much appreciated in India. It grows heavy crops certainly, but it will not do so without manure any more than any other crop.

can be achieved in this direction, and that these results are possible without incurring additional expenditure. In short, grass growing has been made a paying speculation while yet no regular system of management existed. This is a good indication that there is a source of revenue waiting to be developed by the skilful cultivation of grass on waste lands when the proper course to follow in the management—which would reflect more upon the economy of the undertakings than anything else—is discovered and fully made known.

It would appear, from what is already understood of the treatment of grass land, that it is important to have earth banks thrown up round the grass growing areas for the purpose of retaining the early monsoon rains, which are not only charged with nitrogen in a useful form, but are essential for the softening of the ground by sinking into the soil when retained, in place of flowing off from the hard surface, and in so doing removing some of the valuable surface accumulations, as a natural consequence when there are no banks. This in reality is equivalent to a system of irrigation. The practical result for good of the retention of the early rains is very striking in the cultivation of grass. The later rains have not the same effect; they rather tend to make the grass coarse and inferior.

Where manure is available, as near to cantonments or large towns, there is no more certain way of securing a good sward than by supplying a dressing of manure, and during the early stages of the year's growth carefully cutting out weeds and inferior grasses to prevent their increase by seeding. These may be to a large extent successfully formed into silage. Ploughing in addition to manuring[1] is attended with satisfactory results in grass cultivation while breaking in the land, but both operations

[1] At Allahabad it was noticed that "the land that was manured during the rains did not improve this year, but was expected to do so the next year." This seems to be an additional example of the valueless character of dung applied to land when it is very wet.

must necessarily be applicable to a limited extent in speaking of the total grass area.

Another essential matter is the necessity of periodically clearing the surface of the accumulation of grass, especially if it is long or bulky, to make room for the young growth of the succeeding season. This is accomplished by grazing in the ordinary way, by cutting, or by burning after the grass has withered, in the case of large areas which are more or less inferior. If grass is not kept under control in this way—the remarks apply equally to this country and to India—it soon becomes wild and worthless. The inferior varieties, which are often so considered on account of their bulky and woody character in the later stages of their growth, tend to choke and exterminate the finer sorts. And further, the remains of the growth of the previous year cover up the early shoots, so that animals cannot get at them, and likewise hinder the sun from exercising its maturing influence, so that when the shoots do appear they are of an inferior and unattractive character on account of being grown under cover. It may be assumed as a fact that land which is not closely pastured by stock or periodically cleared by fire, say once in two years, soon becomes practically worthless for grazing.

I visited the Government Grass Farms at Allahabad and Cawnpur, and so much interested and delighted was I with the former when I first saw it on the 8th of July, that I paid it a second visit on 23rd July to examine the grasses at a later stage of their growth.[1]

The Allahabad Grass Farm, which now extends to 4600 acres, was instituted, in 1882, by the late Major-General Sir Herbert Macpherson, in compliance with the desire of His Excellency the Commander-in-Chief. The object was to provide a larger and better supply of fodder for the

[1] I wish to acknowledge with grateful thanks the courtesy and attention shown to me by Major Yaldwyn and Sergeant Meagher, the officers who were most intimately connected with the actual management.

animals in the military service. It has not only come up to anticipation in this respect, but it has proved to be a successful financial speculation, in spite of the fact that experience had to be bought often at a high price, on account of the unskilled management which at first it was impossible to avoid. The estimated profit over the whole for crop 1887 was Rs. 20,000.

Some of the manured land which I examined yielded 500 maunds, or nearly 19 tons of green grass per acre—in spite of the fact that the growing season was a short one, owing to the rains being unusually curtailed. The yield from some of the land treated in an ordinary way averaged about 150 maunds, or nearly 6 tons per acre.

Besides about 2000 tons of green grass issued during the season, 1000 tons of hay and considerably over 1000 tons of silage have been stored for future use.

India ought to possess many more such farms. The unquestionable success of this initial effort at Allahabad leaves no ground of excuse for the delay in establishing them at practically all centres where considerable numbers of Government animals are kept. Not only would they save Government money, but they would serve as practical examples, gradually coming into requisition, of a form of cultivation (that of grass), which is practically unknown to the ryot, because it is not necessary for him to follow it until the pressure of population encroaches upon the common grazing grounds. This pressure of population, which is the great incentive to progressive movements on the part of ruling authorities in India, will sooner or later make it necessary for Government to procure fodder in some other way than by the practice of sending grass-cutters, under an order which practically amounts to this: "Get grass honestly if you can, but get it!" The system is not a satisfactory one, even granting that the grass-cutters do take it from common lands to which Government have an equal claim, if not a prior right to that of the people; although we know, as a matter of fact, that cutters do not confine themselves to such areas, from the maimed and injured condition in which they frequently return to camp after having been found deliberately stealing.[1]

It surely is not in the interests of a country that ruling authorities should, by appropriating the produce from common lands, restrict as they do the natural supply of the milk producing or work animals of certain districts where they chance to establish permanent camps for troops. This practice does not dispense equal justice. Even less excusable is it to continue a system of things which creates unnecessary heartburnings, by Government officers persistently becoming abettors in actions which, if performed in this country, would be punished by a term of imprisonment with hard labour—especially when an alternative scheme of undoubted promise is available.

Cutting by hand is found to be most suitable at Allahabad, on account of the presence of ant hills and rat holes. The price paid is 3 pies per maund of about 80 lbs. A good man can cut 15 maunds a day, and might make Ans. 10, while a woman might earn Ans. 6.

A mowing-machine has been successfully used when drawn by an elephant, which is more steady than bullocks. The latter are also too slow for a machine with the ordinary arrangements for speed.

The quality of the hay much disappointed me, considering the high-class material from which it was made. When the grass is dug up by the *kurpa*, in place of being cut with a hook, *jabao*, the hay is sandy. And, again, hay made in August and September during the season of heavy rainfall, when the valuable Andropogons are at their best, is almost invariably injured by the wetness. Even when

[1] A pamphlet by Major Yaldwyn and Sergeant Meagher states that the supplies coming from the Grass Farm "prevent constant complaints which arise from the men encroaching on the land of the ryot."

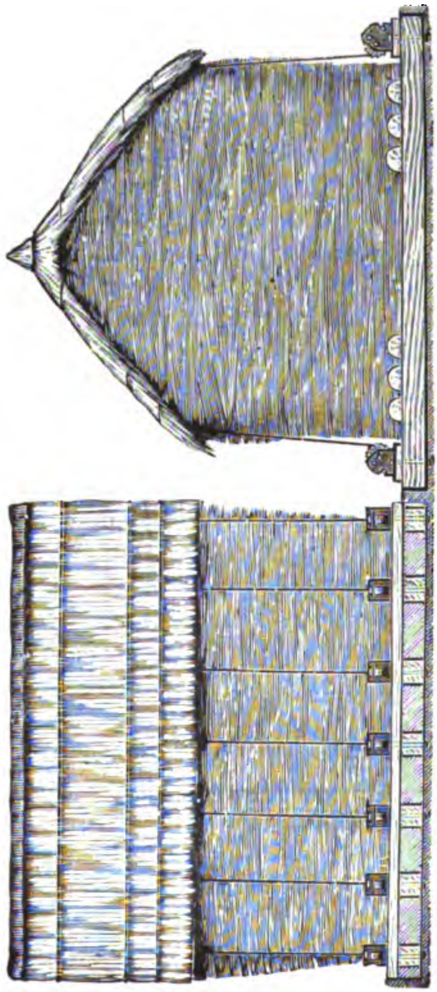
rain is not falling, the atmosphere, the soil, and all surroundings are at that season so charged with moisture that it is practically impossible to make good hay.[1] It is on this account that I believe that silage has a hopeful future in India.

If silage is ever to be effectually established on a large scale for the benefit of a great community, it will be in India. Although I am no advocate of the general adoption under all circumstances of systems of ensilage in this country, yet I believe the adverse climatic conditions met with in our Eastern Empire are such as could be overcome in a marked degree by making silage on an extensive scale. Modern inventions and recent experience have produced methods by which ensilage can now be practised at a merely nominal expenditure of capital. It is not necessary to build an expensive house or silo. It is even unnecessary to dig a hole in the ground to contain it. All that is required is to build the grass into a good large stack on the surface of the earth, and tie it down tightly with galvanized steel-wire rope. Some who pretend to have a special gift in the matter of reading native character, say that a native will never come to bury good food for cattle in a hole in the ground. Surely they can have no objection to building it in a heap where they can always have an eye upon it!

"Johnson's" apparatus is most simple, convenient, and efficacious. The resulting material, if properly managed, is sweet silage. To secure this the temperature must be allowed to get up to 120° F. before it is pressed sufficiently to exclude the amount of air necessary for the support of the process of acid fermentation. Sweet silage is in no

[1] Ozanne, speaking of native practices in Bombay, says: "Hay" (as the material is known in England) "is not made in India. The grass is either cut green and fed to cattle at once, or it is left on the ground to seed, and is cut when it is fully matured and when the monsoon is over." Any practical man will easily see what waste this must entail, though the climate makes it necessary, unless a system of ensiling be adopted.

way disagreeable in smell, and perfectly suitable to give in moderation to all sorts of farm stock.



"Johnson's" Ensilage Stack Press.

The left of the figure shows a side view of a stack of silage made of green grass; to the right is an end elevation. The underlying wooden beams on which the stack is built appear with the improved "Ratchet Drum," by means of which, through the aid of a hand lever, the wire ropes passing over the stack are tightened and the pressure applied. Cost of apparatus for a 15-ton stack, £12, 5s.; for a 100-ton stack, £21, 8s.—*Plate kindly lent by The Aylesbury Dairy Company, London, who own the patent.*

Silage made in pits has been successfully and profitably made in India, while those concerned were in ignorance of the improved methods and the efficiency of the systems employed in England. All varieties of grass-eating animals have been experimented upon with favourable results, though it must be admitted that the prejudices of certain military officers have not been quite overcome. The case for silage as regards military horses had, so to speak, been lost in the Outer Court; but I have every confidence that in a little while the Inner Court will reverse the decision of its subordinate one, and silage will become a universal ingredient at certain seasons in the food of all draught animals in the Government services. Misunderstandings, no doubt, arose, and mistakes were made. It would have been unnatural had it not been so at first. But however much blundering may retard a good system, it is unlikely to prevent its ultimate success. I can strongly sympathize with the objections of an officer in charge of a number of valuable horses, which had been tried with badly-made, rank-smelling, sour silage, and subjected to all the dangers of a sudden change from dry to succulent food; or with an officer who pronounced the silage bad after it had been removed from the silo for a week, and an effort made meanwhile to dry it! Attempts such as these, and many others which have been made, involving as they do a variety of erroneous notions, are quite on a different footing from a system of management where silage, composed of good grass and made under proper regulations affecting the temperature, is given as one ingredient in a suitably balanced dietary. When silage is well made, it differs very little from grass in either its properties or its composition. If one is able to say that his horse should not be allowed to eat grass, he may with safety infer that it should not have silage; but if there is no objection to its having grass, there can be no reason, other than prejudice, which should prevent it from being allowed good silage in moderate quantity. It should be remembered that succulent food of all kinds requires to be given with greater caution in India than at home, and this remark applies more forcibly at certain seasons. July grass, for example, is very liable to induce scour in horses.

Successful Results.—At Utacamand I found well-constructed siloes built of masonry at one of the Government cinchona plantations,[1] and their contents were highly appreciated. Silage has been a great success at the Hissar Cattle Farm, from the various points of view of economy, usefulness, and convenience. It is said that "Rs. 40,000 are now saved annually by giving half rations of silage along with hay." At Allahabad the cattle, though not the horses, were successfully fed on it.

General Sir Herbert Macpherson was in this quarter the great pioneer of the ensilage movement as he was of the cultivation of grass. His much-lamented death was a serious blow to the rapidly-progressing and much-needed improvements of the forage division of the military commissariat. Had General Macpherson lived, the question of the moment would not have been, "Shall the existing grass farms be done away with?" but rather, "At how many centres would it be suitable to establish farms on the pattern of that at Allahabad?"

No doubt the management of a farm is an unpopular part of the service for an ambitious young officer. He goes to it perfectly ignorant of his work, and unless he has "a special turn for it," he comes away after a term of years in much the same condition. There are cogent reasons why the executive officer on a farm of this sort should be a trained agriculturist, not a soldier.

To sum up, I believe India is the great field for the development of ensilage. Though bad results have followed in some instances—through ignorance and unskilled management—enough successful work has been done to show that the very best silage can be made when the

[1] A large *Briza* was practically the only grass growing under the cinchona trees. It made silage of excellent quality.

efforts are properly directed. The conditions of the climate are such that by depending upon the ordinary methods of preserving the abundant natural supply of fodder in a dry condition, much loss is entailed. And again, no country in the world is reduced at times to greater straits in the matter of supply of food for man and beast. The moisture contained in the food substance I believe to be a decided advantage in an Indian climate. There is nothing in the surroundings which will prevent the contents of a silo from keeping in good condition in India quite as long and quite as well as at home. I heard of numerous successful results from siloes which had remained fifteen months before being opened; and at Allahabad I rode over the top of one which, by the orders of Sir Herbert Macpherson, was filled and covered up with earth three years before. The fact that my horse did not sink showed that after settling no material change had taken place in the bulk of the substance stored below, and made it extremely probable that the experiment would ultimately turn out successful.

I may say in concluding this chapter, that I look upon the possibility of enormously increasing, by the use of proper methods, the grass production of India as one of the most important of the means available to Government in the future for averting the impending evil of an overcrowded population. Not only will the increased grass-supply be a direct benefit to the live-stock of the country, but every extra ton of grass grown also induces greater fertility in the soil, in virtue of the accumulation in it of an additional amount of crop residue.

CHAPTER XXIV.—FORESTRY.

Importance—Commencement—German, French, and British Schools—Dehra Dun—Denudation—Dangers to Agriculture through Forest Conservancy—Forest Fires—Influence in keeping down Insect Crop-pests and Fungi, including Ergot—The best Interests of the Empire—What India wants—Conclusions arrived at—Pellagra—Cause of Native Discontent—European Systems of Forest Conservation unsuitable.

THE **subject of forestry** has a peculiar importance, on account of its being intimately associated with the interests of agriculture. **Reboisement** of waste lands is a most urgent necessity in India, and if properly, *i.e.*, judiciously and extensively, carried out would prove to be of almost incalculable value. On the other hand, if from lack of special knowledge the interests of agriculture are made to suffer, afforestation may become a serious hindrance to progress, and the practice of it a wrong and injurious one to pursue, however much it may seem to promise prospective blessings.

Forest conservancy in India began in a small way about 1855.[1] Even now the Forest Department is only in its infancy, though growing rapidly in efficiency and importance. The first officers who were appointed to this branch of the service had no special training in the technology of the subject, and, as might have been expected, their services were by no means uniformly satisfactory. Now, however, it is recognised that as a special Department it demands a specific course of study.

No little difficulty exists regarding the training of young forest officers. **The work of the German School,** which

[1] The Indian Forest Act was not passed till 1878; the Burma Forest Act not till 1881; nor the Madras Forest Act till 1882.

for minutiæ of detail, general scope, and thoroughness, is the finest in the world, is admitted to be too elaborate for the requirements of India, and not altogether in the right direction. **The French School** has been abandoned by the British Government, with the object of supporting the College of Cooper's Hill, to which they are in a manner bound. **The forestry curriculum at Cooper's Hill** is merely a make-shift, and not altogether satisfactory as regards its object. This is mainly due to want of proper facilities for practical instruction, and to many of the collateral science classes, which forestry students are required to attend, being taught with a special bearing on the subjects suitable for students undergoing training for other branches of the Government service. An additional disadvantage is the cost, which is far above what it might be or ought to be.

It would be a better arrangement, both for the students and for the Forestry Department, to provide in this country a sound theoretical course extending over say about two years,—such a course as might be provided *for one-half of the present expenditure*, at Edinburgh, or any other centre similarly situated as regards conveniences offered for practical demonstrations in well-managed public or private forests. The final stages of the course of training could then be most advantageously and economically undertaken in India, say at the existing School of Forestry at Dehra Dun, which, however, would require to be elevated to a school of higher status and greater proficiency. Not only are the details of management of Indian forests quite different, but the trees are also different from the trees of Europe, and consequently a knowledge of the natural rotation of European forest trees would be no guide to the natural rotation of forest trees in India. When a more perfect knowledge of natural rotations and of the conditions suitable to natural reproduction and growth of forest trees is arrived at, much valuable time and public money will be saved. The prominent advantages of the proposed scheme, as compared with the present arrangements, are the material reduction of the cost of educating forest officers, and their gaining their practical experience by training in the identical class of work which they are ultimately intended to undertake.

Denudation.—It is an undoubted fact that large areas of India have been shamefully and wastefully denuded of valuable timber within comparatively recent years. The large and increasing demand for wood for railroads and for building purposes encouraged it, and the want of any Government supervision or interference permitted it. It is quite sad to look upon the bare hills and barren plains where extensive forests were recently in existence. I came across a number of such places. The naked hills in the Simla district bear testimony to my remarks. The surroundings of the mountain capital of India would have borne a very different aspect had Government taken the advice of the present Marquis of Tweeddale—at that time Lord William Hay, Commissioner of Simla—and preserved all the forest around within a radius of 10 miles. It is only fair to draw attention to the fact, that the spoliation of valuable timber was not the work of the ryot or cultivator for local purposes, but the work of contractors employed in supplying extraneous demands.

However much the existence of forests may affect the rainfall in other countries, I do not believe that, if even the limits of afforestation had been reached, the amount of rain in India would be materially increased or appreciably altered in any way. The influences which affect the rainfall of India are of too great magnitude to be easily affected by local circumstances; but the primary function of a forest in India is the retention and distribution of the rain or moisture. Trees act as a natural covering to the soil, into which the rain sinks, in place of accumulating and running off by surface drainage. On steep hill sides the denudation is carried on with great force by the sudden accumulations of water, which breaks the surface and tears up the soil as it descends, and finally deposits a mask of debris on some alluvial tract below in a rough and valueless condition.

Government have only recently awakened to the fact, that their duties as regards the protection of forests have not been undertaken in the past. The danger now confronting us is not that there is fear of forestry being neglected, but that in the excessive zeal to make up lee way the other extremely important interest of agriculture may be made to suffer, not intentionally, but from ignorance of the main facts, and, what is perhaps even of greater importance, their numerous collateral issues. It has been established that large tracts of land belong to no one, and consequently are naturally Government property; but to certain products of the natural growth—for example, grass for thatching, food for cattle, timber to make their implements, and poles to build their houses—the native population of the adjoining cultivated tracts have from time immemorial had the undisturbed privilege of resorting to supply their wants. No one denies that Government has the undisputed right by law to discontinue these privileges; but I appeal to the common sense of every practical farmer in England who knows the value of the products enumerated, if to exert such a right would not be a policy worse than suicidal in a country which practically depends upon agriculture for its wealth and prosperity.[1]

Government has to a certain degree put on the screw in what, speaking of the Empire, might be termed limited areas, though as yet to a small extent as compared with its power to do so; but the results are so unsatisfactory, that they ought to be a sufficient warning that the policy requires to be amended. In travelling, as I did, over a very

[1] An able article, on the subject of Waste Land, printed in the *Scotsman* of June 7, 1888, throws light on this question.

wide area, I, in my non-official position, had very exceptional opportunities of seeing how the forest regulations pressed unnecessarily upon the people, and of hearing their bitter and oftentimes well-founded complaints.

I came to the conclusion, that however numerous and however effective the calls for the establishment of an Indian Agricultural Department might be, there was none so urgent as that for the protection of the interests of the Empire, apart altogether from the interests of private individuals, against the encroachments, however well intentioned, of the Forestry Department. What has been accomplished by this department is merely a fraction of what will be undertaken sooner or later. There is no reason why forestry should not be greatly extended, and that to the advantage rather than to the detriment of the agricultural community; but already it has been shown that this cannot be safely left to the ordinary civilian and forest officers, who cannot understand, however much they might strive to do so, the bearings of certain changes on a matter so complicated and so intricate as agriculture. The greatest interest in the country will always continue to suffer and to be sacrificed until Government sees fit to employ officers who are capable, from their own special knowledge, to advise in regard to all matters which affect the agricultural interests.

Another prominent sign of the hollowness of the present policy is the fact that much of the valuable time of the heads of the Forestry Department is taken up in fighting the Agricultural Department. This is merely a matter of history repeating itself, and as in the old story of a quarrel arising between the servants—the chief butler and the chief baker—of a great lord, the one who for the moment is not in favour gets worsted, but the greatest loser is the master himself. The triumph of one servant over the other is at the master's expense: his interests are sunk in the efforts of each to gain supremacy.

The one great advantage which the Forestry Department has over the Agricultural Department is that by drawing on the products of the natural growth of past generations, and by depriving the cultivators, who have no one adequately supported to advocate their cause at head-quarters, it can collect money sufficient to pay its expenses; while, on the other hand, the Agricultural Department is essentially one devoted to education, the collection of information, and to the protection of public interests, without having any internal source of revenue. It possesses that negative quality which is always associated with Scotch frugality—it makes wealth to the country by saving it; but though intrinsically valuable, it, like the function of the chief baker, does not appeal to the momentary and temporary gratification of my lord, as do the services of the chief butler, for one who is prepared to sacrifice the substantial benefits of the future for the fleeting and hurtful pleasures of the moment.

The differences between the two departments should be settled on the lines of a great national policy by those whose views are not hampered by departmental surroundings. The whole circumstances should be viewed in the light of the best interests of the country, and not with regard to what is going to yield the largest return to any single department, heedless of what the consequences may be to other departments which have interests involved. The common-sense view of the position is this, that the balance-sheet of the Forestry Department should be made a minor consideration as compared with the interests of cultivators of the soil, singly or collectively. I hold that to cause a loss of, say one unit, to agriculture by gaining two units for the forestry is a net loss to the country, as the after-consequences of the loss of one unit in agriculture may be exaggerated in the future by tens in place of units. **Forestry is much more confined** to the support of its own interests than agriculture, which has so many interests depending upon it. The views of forestry, as regards its own interests, were formed more on theory deduced from European practice than from experience of the details connected with work in India.

I am not at all sure that time has confirmed the interpretation of what were at first considered the best interests of forestry.

In the destruction of the valuable **forest at Murree,** in May 1887, is a pointed example of what will happen when attempts are made to prevent forest fires. Till only a few years ago, the annual fires passed through the forest without doing any great injury to the trees, but when undergrowth was allowed to accumulate, as in recent years, the ignition of this caused great destruction of timber.

There are two points as regards the agricultural interests of special importance in the future, should forest areas greatly extend without the annual clearing out by fire, viz.—(1), that insect crop pests will unquestionably increase. The recent investigations of Miss Ormerod, the distinguished entomologist of the Royal Agricultural Society of England, have clearly shown that the accumulation of natural undergrowths, such as I refer to, is much to blame for the injury to our crops resulting from insects: And (2), the pasture, specially valuable in the hot weather when shelter is a conspicuous advantage, will be greatly curtailed. To leave coarse grasses from year to year without burning simply means making them almost worthless for cattle, even if these latter were allowed into the forbidden areas. The facts connected with the firing of coarse pastures are identical in India with those at home. Being specially interested in this matter, I made throughout my journey numerous inquiries regarding it. It seems to me that one of the most serious dangers ahead in the stoppage of forest fires, if successful, is the increase of vegetable tree-parasites, and the dangerous and deadly fungoid grass-parasite, ergot.

At Jethwarpur I saw what had once been a splendid avenue of large trees in the last stages of destruction by Dodder, *Cuscuta*. I also noticed considerable damage to trees at Poosa by the same parasite; and on the Allahabad Grass Farm it was sucking the life from the Babul hedges. In a restricted area I have no doubt but that to shower the affected plants with a solution of sulphate of iron would destroy it, as in the case of clover Dodder, *C. trifolii*, in Europe. There is, nevertheless, no remedy for keeping it in check like fire. If it once takes possession of a forest tract nothing but fire will save the trees from total destruction.

Ergot will enormously increase if old flowering stems of grasses are left to disappear by a process of natural decay. The point of greatest importance connected with the presence of ergot is, that not only are the pastures in the forests made unsuitable to all classes of farm stock bearing young, owing to the almost certain consequence of abortion supervening on the consumption by them of ergotized grass, but there is every probability of ergot spreading from the forest reserves to the cattle pasture outside, if the forest is made a stronghold from which it can be constantly recruited.

It has been made apparent within recent years that the injuries resulting from animals living on ergotized pasture are not confined to those bearing young. Two years ago, Young of Brokley Park, Queen's County, Ireland, traced a deadly paralytic affection among his ewes and lambs to the presence of ergot in their pasture.

Though it may be necessary on a small scale, and for special purposes, to strictly protect certain forest areas, and reserve them exclusively for the growth of certain trees, yet, in considering the whole matter, by all means encourage the growth of forest trees, but let it be in a place where their shade—one of their first functions, and for which animal life in a tropical climate has to be thankful—will benefit the animals under domestication, and not be solely reserved for the advantage of the wild deer and the wild pig.

The best interests of the Empire must suffer if the main object of the efforts of the Forestry Department is reduced to the *growth of forest timber.* A supply of timber, however excellent, will seldom repay even the smallest sacrifice of the interests of the present generation of inhabitants. A forest which has to be artificially nurtured swallows up in expenses, long before it is cut, all its final sale value. The country must not look to a forest as able to supply anything more towards the revenue from extensive conservation than the penny savings bank does to increase a boy's income. Both are useful in their own sphere, but they can be abused much to the injury of the body politic. If the boy starves himself by banking all his pence in place of purchasing his dinner, he will certainly, unless some one breaks his bank, have more money at the end of a month than he would have had if he had bought the food required to support his system; but, further, he will most probably have induced a weak or diseased state of health. In the same way with a Forestry Department which expends most of its energy and income on the rigid protection of small areas,—the final value is greater, no doubt, but at what a sacrifice! Not a sacrifice in any way to the forest officials themselves, nor yet a sacrifice which a forest official can understand, because he has not gone through a training which could qualify him to judge of the facts. It would take a forest officer years of hard study to be even partially qualified to judge of the injury done to an agricultural population by the shutting up for forestry purposes of the land on which the cattle graze. For example, there are certain places which hold out longer than ordinary pastures in times of scarcity. These are kept in reserve, and not often resorted to, but they are simply invaluable to the district to which they belong. I have heard forest officers declare that these were the places to close, because only used at intervals, possibly of years!

What India really wants in the way of forestry is an *enormous* extension of the basis of forestry operations, but not necessarily a proportionately increased expenditure. If the money now devoted to keeping down periodical forest fire,—that natural process of healthy retardation, cleaning and thinning, which has gone on from time immemorial, and under which all the magnificent forests of India have been nursed and reared,—that annual safeguard against injurious fires, injurious insects, and unhealthy malaria,—were only utilized in promoting the growth of trees, and also natural pasture grasses, on all sorts of waste but not worthless land, the benefit to the country would be immediate and real, not prospective and hypothetical.

It would be quite competent under such an arrangement to have large tracts of land principally devoted to the growth of trees, grazing being only the secondary though at the same time a substantial consideration—say that the land produced two-thirds trees, and one-third pasture. Other areas would have grazing as the first object, and forest products proper as the second, the relative proportions of trees and grass being reversed. The browsing of cattle and the periodical fires would keep down undergrowth to such an extent that firing could do but little injury to the timber. Some such arrangement is necessary, looking forward to the future increase of population and concomitant increase of cattle, and also to the growth of forest areas. By the rigid preservation and exclusion from the pasturage system of areas taken up by the Forestry Department, there is a loss from the already too often over-stocked area of natural cattle pasture; whereas, by the other system of cultivating trees and grass together, the available food for cattle would be actually increased.[1]

[1] Duthie most appropriately points out that sufficient notice has not been taken of the amount of forage which may be derived from the leaves of

I have arrived at the conclusion, that however excellent pasture may be in India, the full benefit of it cannot be reaped unless a considerable number of trees are present in it. As pressure of population increases, relief will be found not only in improved cultivation of the tillage soil, but by the improvement of the natural pastures, to enable a given area to support greater numbers of stock. Fortunately for the Government of the future, there is great scope and good prospects in this direction, as explained in the chapter dealing with grass land. By cultivating pasture, the Forestry Department would reap a steadily increasing and perfectly legitimate revenue from letting grazing rights. This is a point of great importance, and one which requires not only care and consideration, but wide knowledge and experience in a special direction. **Serious injury might be done** under either of the two following circumstances:—(1), If sufficient pasture were not left available for the cultivators, not only for their work bullocks, but also for their milk cattle, including buffaloes; and (2), if the charges were made too high for the poor in certain districts to pay. Injury from both causes has been brought to my notice, and it only required to be carried a little further to become a national calamity—quite unexpectedly, of course, because there is no one interested who can judge of the facts or their bearings. A forest officer cannot be expected to see a matter of this sort, and there is no sufficiently equipped Agricultural Department to act as guardian. From one or other of the above causes the people in certain districts were, on account of the imperative necessity of first providing for their work bullocks, unable to keep the milch cattle required to supply milk or its product ghi—that practically indispensable ingredient in a healthy native diet. The significance of this will be found by a perusal of my remarks on the physiological action of ghi as the fat of

trees, which are not so liable as grass to be affected by a want of surface moisture.

food in the alimentary system. A few strokes of the pen of an officer, ignorant of the facts of agriculture, might, in an indirect, and consequently insidious, but at the same time certain way, plunge millions of unsuspecting wretches into all the miseries resulting from imperfect alimentation, beginning in the present, and accumulating in virulence in future generations!

The history of the loathsome disease *Pellagra*, which has extended so much among the poorer classes of Italian peasantry during the present century, ought to be a warning to all civilized governments of the danger underlying any policy which will tend to reduce the standard of the staple food of the lower classes. Some of the common Indian, so-called, *leprous* diseases resulting from inferior dietaries would be, in my opinion, more correctly described as *pellagrous* diseases. When there is a natural tendency to such diseases, the necessity to avoid anything incentive to them becomes urgent.

The native population, who feel the pinch of Government resuming the rights which had been by common consent granted to them since the time we took possession of the country, may well say, Why should Government want to grow great forests of large timber? It is of little value to the masses of the population, whose wants are supplied by sapling poles and branches, and by the fruit and shade of such trees as they or their cattle can get access to.

While in no way condemning the salutary principle of present self-denial for future advantage, either to the race or to the individual, I confess that I sincerely sympathize with the native population of India, who, through a policy necessitating involuntary abstention on their part, have to give up conveniences, and what are in many cases essentials of their very existence, for an object incapable even of benefiting their descendants.

That any one will profit by the system is a matter which yet remains to be seen. It is known that magnificent trees have been grown in India under ancient practices already referred to, but it has yet to be proved what those forests which escape injurious fires like that spoken of at Murree will be worth when they come to maturity in the overcrowded condition in which some at least are now springing up.

In conclusion, as regards the matter of Indian forestry, too much success has already attended the effort to graft the European system on to the Imperial management under the Government of India. This has been made possible by the Forestry Department drawing on the resources of the timber growth of the past, and reacquiring rights of what was before used as common property for its support, in place of going to the Government Exchequer in the usual way. It has succeeded in living upon the resources of an industry (agriculture) which has little power of self-protection, because the people are not accustomed to combine for purposes of representation, and because they are inadequately represented by a Department which carries no direct income to Government.

I believe it will yet be shown, when fully investigated, that European systems of forestry are as unsuitable to the conditions of India as European agriculture would be if adopted, and that the more nearly Nature is imitated, or the best native practices followed in both instances, the more successful will be the final results. The trial by fire, which has been carried on for thousands of years, must have spared only those trees which could develop recuperative power sufficient to withstand it. Nature has trained them to successfully resist this danger, while by means of the fire she protected the trees and the pasture grasses against the attacks of other enemies, more especially against the ravages of insects and the growth of parasites, including fungi, which very frequently propagate, in the first instance, on old, decaying, or weakly specimens, but finally, when abundant, spread to healthy vegetation as well. Trusting to the external protection of fire, the trees or plants subjected to the new mode of life are, as it were, untrained to resist, and unable to overcome the dangers which the fire kept under control. The question may not be ripe for final settlement, but everything seems to indicate that before long it will be the urgent duty of Government to make a thorough investigation for the double purpose of discovering—(1), In what way the rigid protection of certain forest areas is injurious to agriculture, and consequently to the country; and (2), What influence the system of strict conservancy is likely to exercise on the growth of the timber supply of the future.

CHAPTER XXV.—CHEMISTRY.

Functions of Chemistry—Work which an Agricultural Chemist might Undertake—What India Requires—Advantages a Chemist would confer on Native States—The College of Science, Poona—Dehra Dun.

CHEMISTRY supplies the great framework of scientific agriculture. A knowledge of the fundamental truths and principles of general chemistry should form the solid foundation, and agricultural chemistry the superstructure built for actual use.

An agricultural college or an agricultural department without an agricultural chemist is like an animal without the backbone which was originally intended to form part of its structure. Naturally one would expect it to be limp and unhealthy, and unable to perform any useful function, its time and energies being mostly absorbed in a struggle for bare existence.

Repeated references have been made in the foregoing pages to work which a chemist could most advantageously undertake. It is needless to re-enumerate them in this connexion. Suffice it to say, that the light which chemistry could be made to throw on ordinary everyday operations, both agricultural and industrial, would, if the opportunity were offered, find its way more or less effectually into every corner of India.

Not only might old industries be aided, but new industries could be started. In place of importing sulphur from Java for sulphuric acid manufacture (a trade increasing with the extension of the use of aerated waters), chemistry could show how the native pyrites of the Punjab would give as good results at much smaller cost. By the aid of chemistry the manganese of Jabulpur and the hills of gypsum in Northern India might be converted into sources of revenue. The harmful export of bones might be checked by demonstrating their value as bone superphosphate.[1] These are merely given as indications of what might be done by chemistry in a special direction. I believe that the scope for the development of chemical teaching in all its branches in India is enormous, and the good which it could bring about incalculable.

What India requires, in the first instance, is an agricultural chemist with a European reputation, engaged for a term of say five years, to initiate the department and to properly organize the work. He should be called Scientific Adviser to the Government, and, on account of the short engagement, a salary of £1500 yearly would be necessary to secure the right man. This would not necessarily be an additional charge upon the Exchequer, because I believe that, if a competent agricultural and industrial analytical chemist were provided by Government, with a properly appointed laboratory and a good staff of native assistants, he would, by taking in work from private firms, in the course of a very few years earn more than the initial annual expenditure.[2] An arrangement could be made so that a portion—say two-thirds—of the fees would go to Government to meet the outlay of the guaranteed salary, while that remaining would supply an incentive and reward for extra work to the head of the department.

The duties of this officer would not be altogether confined to original research and routine analytical work; but he should undertake courses of lectures in a central agricultural

[1] I came across two instances where broken bones were being used as manure by educated natives.

[2] For example, I heard of one paper-mill concern offering to pay a portion of the salary of a chemist to help them to find out about bleaching materials, and how to utilize *usar* salts in place of importing soda.

college, to which natives should be sent from native States and different parts of the Empire to study.

Had I not information of a definite kind on which to base my belief, I might safely infer, from the large-minded and liberal system of management which is adopted by the Baroda State, that if a competent teacher of agricultural chemistry existed in a well-equipped institution of learning, such as the College of Science, Poona, one or more picked men would be sent to study under him, with the object afterwards of becoming State teachers. I point out this fact to show that the want of a competent agricultural chemist is retarding the progress of the more enterprising of the native States, as well as of the portions of the Empire directly under the Imperial Government.

The College of Science at Poona is an institution such as I would gladly see provided with an agricultural chemistry lecture department such as I describe. Classes are available in nearly every subject related to agriculture required in the training of agricultural pupils; and since I returned I learn that arrangements have been made whereby land for experimental purposes is now available.

Although I believe that more immediate good could be done by placing the head of the Chemistry Branch of the Agricultural Department at Poona, because in the matter of surroundings everything is ready for him,—at the same time, I do not expect that one appointment like this will be sufficient to cope with the requirements of the whole country. There would be a conspicuous advantage in having more than one European officer in a new department, as in a matter of so much importance it cannot be satisfactory to risk everything on the life of one man. A younger and less experienced officer as a beginning, receiving less than half the salary—say £500 to start with—might with decided advantage be placed at Dehra Dun; but as the main centre this School has one serious objection—it is not a School of Agriculture, but a School of Forestry.

It may sometimes, on the ground of expediency, be allowable to graft a new subject on to an institution doing work of a different kind; but the fact should not be lost sight of, that if men taking up two or three different lines of study are, for matters of convenience, made to attend the same course, time must unquestionably be lost. Though many portions of the subjects pertaining to general principles may be on common grounds, still, students of agriculture ought to have the advanced portions of the science of chemistry treated in a very different way from that suited to forest officers, and *vice versa*. On this principle the Agricultural Department was in name, and to save it from obliteration, added to the Revenue and Settlements Department; but although it bears the name it does not fulfil the functions of a real department, and I certainly do not think that the preservation of its dry bones, without the flesh and muscle of a live department, can be pronounced a success. All due credit, nevertheless, to those who, from praiseworthy motives, planned its rescue from extinction. Moreover, I have no doubt but that the decision was the correct one under the circumstances at the time, because had fortune smiled upon the country, and had financial difficulties not continued to press, very different results might have been got in the position retained.

CHAPTER XXVI.—VETERINARY SCIENCE.

Defects of Veterinary Science in India and in the United Kingdom—Importance of a Veterinary Branch of the Agricultural Department—Method of securing it—Scholarships—Salaries—Further Study in India—Text-Books.

THE great defect of veterinary science as regards India is the same which is experienced by farmers at home. With few exceptions, the minds of veterinary practitioners are stored with matters relating to horses, but they know little of cattle, and practically nothing of sheep. This is easily explained. There are much greater profits or fees connected with the treatment of horses than in the case of other farm animals, and, besides, the men who are attracted to the profession are often induced to join it on account of their appreciation of a horse, or the interest they feel in matters pertaining to the turf. These facts limit the usefulness of veterinary practice in this country; and so far as the Indian cultivator is concerned, they make it practically of little value. Veterinary science finds a place in the curriculum of more than one agricultural college in India, but I believe the teaching of it, as at present carried out, is productive, indirectly, of more harm than good.[1]

It will be seen at a glance that it must be a waste of energy to teach horse pathology to a young ryot who may never possess a horse, and, possibly, never saw more than one or two until he went to college. Further, to be made

[1] The Veterinary College, Bombay, under the able superintendence of J. H. Steele, is not included in this remark.

to study what even a schoolboy must perceive is palpably of no value to him, cannot fail to be demoralizing and disheartening. As a matter of fact, this branch of study is most unpopular.

It would be very different if it were, as it ought to be, a subject dealing with the animals which natives are reared to reverence as sacred. It would then be not only interesting but useful. Before instruction could be properly given it would be necessary to train the instructors. The lecturers have in the past been borrowed from the military staff, and were admittedly excellent men in matters relating to horses, but, as a rule, unwilling and unable, even if willing, to do satisfactory work in any other branch of the profession. The reader will understand of how much value in matters pertaining to cattle the instruction of one would be who could, without meaning to be amusing, ask the question, "How is it possible to treat an animal which possesses well-nigh half-a-dozen stomachs?"

There is no doubt it is extremely important that India should have a well-equipped veterinary branch of her Agriculture Department, composed of men who have made a special study of the diseases of cattle and sheep. Young men such as are required are not now to be found in England; for a special purpose like this they require to be, as it were, made to order. Two or three scholarships of £300 or £400 each should be offered for competition to first-class graduates from Bombay Veterinary College, or any of the veterinary colleges of the United Kingdom, but open only to men who have been for some years in full practice. The intention being that each scholar should, before proceeding to an appointment in India, spend a year in the United Kingdom in the special study of cattle diseases, including the use of the microscope, inoculation for contagious diseases, and the artificial cultivation of microbes. By assistance procured through the veterinary colleges and the leading agricultural societies there would, unfortunately in one sense, be little difficulty in securing ample material to enable these bursars to gain the experience necessary. Their rate of pay in India should, under ordinary circumstances, be similar to that of corresponding officers in the Agriculture Department, but extra inducements might with advantage be offered to men who did exceptionally good work during the year of probation. On arrival in India, the further study of disease would proceed along with the study of native languages. If it were possible to secure men of the right stamp from the Veterinary Department in India, some time would be saved over the matter of learning the ways of the country; but the special study of diseases at home would be necessary in any case.

When these preliminaries for the education of teachers and for the collection of information to form text-books have been passed through, then, but not till then, will the teaching of veterinary science be of value to the native population of India.

In addition to the good which such a Department would directly exercise, it would, in common with a Chemistry Department and the Agriculture Department now to be described, help to relieve the superfluity of educated natives who have taken advantage of our liberal, possibly too liberal, system of education without any means of subsequently finding employment. Perhaps the greatest source of discontentment in India is the supply, so to speak, of education being far in excess of the demand for the services of those who are educated, combined with the fact that a course of higher education as now given makes men unpractical and unsuitable for ordinary native occupations. A man who reads English will not, as a rule, work with his hands, and if he fail to find Government employment, he must starve or remain a burden upon his relatives.

CHAPTER XXVII.—A DEPARTMENT OF AGRICULTURE.

Unsuccessful Efforts to Improve Indian Agriculture—The Result—Suitable Agriculture Officers—Test Examinations—Examiners—Misapprehensions relating to "Cirencester Graduates"—Value of an Agriculture Diploma —Work of an Agriculture Officer—Salary—Objections to this Proposal—Preparation of Reports—Text-books—Moral Influence—Recommendation of an Agriculture Department by the Famine Commissioners—Land and Statistics and Revenue Department, Bombay—A Degree in Agriculture—Employment of "Cirencester Graduates"—Spurious Advice given to Government—Necessity for Skilled Advice—Experiment as a Means of Improvement—Difficulties—Ozanne's Experiments—Allen's Experiments —Agricultural Shows — Honorary Distinction given as Rewards for Public-spirited Conduct—Development of Local Effort—Improvement of Crops—Duties of an Agriculture Department—Quotations—Minute of Lord Mayo's Government—Report of the Famine Commission—Suggestions by Col. P. Dods—Conclusion—Reduce Grants to other Departments, including Education—*Churchill* The Public Works Department—Injury done by it as at present Constituted—The Remedies.

UNSUCCESSFUL EFFORTS TO IMPROVE AGRICULTURE.

PERHAPS the most regrettable fact in connexion with India, especially in the matter of agriculture, is that the efforts which have been made to improve native practices have frequently been carried out on lines which never had the remotest chance of leading to success. It is most disheartening to read from that reliable and excellent publication, "The Famine Commission Report," of the large sums of money, amounting to many thousands of pounds, that have been lost to the country; of the Model Farms by the dozen that have at one time and another been started in many parts, and in a few years wound up in a bankrupt condition—all due to the one blunder which, as such, like the elixir of life, seems to have successfully evaded discovery. I refer to the persistent and universal employment as farm managers of men who had no truly agricultural training, either practical or scientific,—such men as gardeners (some of them very excellent men in their own department), unsuccessful planters, or other officials with equal claims for consideration. In addition to these officers (with one or two notable exceptions) having no knowledge of English agriculture, there has never been any *systematic* attempt to get them to learn what is known by natives of the principles underlying native practices. It is not difficult to see, and no practical man will wonder at it, that climate and general surroundings being so vastly different in India from those at home, British and American practices must be unsuited to Indian conditions.

The Result is perfectly natural.—So many failures have destroyed the confidence of Government, and anything agricultural that is now being done by them is reduced to the merest minimum, with a chance any moment of being utterly abandoned. It is an extraordinary anomaly that such a vast Empire, virtually supported by the produce of her soil, should have no department of agriculture worthy of the name to guide and support the most important interests. If Indian agriculture were perfect, or if it were in any way approaching to a satisfactory state, there would be some excuse; but Indian agriculture is far from perfect, and is capable of much improvement if it were entered upon in a proper manner and were entrusted to the right men. No one, however able, can ever teach a subject he does not know himself, at least where practical matters come into play. The first step to be taken is *the study of native agricultural practices* by men who have been trained in agriculture from their early youth in this country, and who have subsequently acquired a sound knowledge of the sciences bearing on the subject. This is, I think, almost the only method which has not had a trial in India, and it is the only one which could be successful.

Matters have at present come to such a deadlock that something extraordinary must happen before any improvement can be brought about. The confidence of Government in the possibility of agricultural improvement is thoroughly shaken. There is an impression widely abroad that the Indian ryot knows much better than we do how to work his land and grow his crops. Assuredly he knows much more than any European whose business is not agriculture, and there is no one whose business is agriculture that I could point to in India; but the ryot certainly does not know more than a Scotchman or an Englishman would who had been selected for his proficiency in the science and practice of British agriculture, and whose duty it had been for a term of years to make himself thoroughly acquainted with everything connected with Indian agriculture. I am speaking advisedly when I say that no such individual has ever held a position in the employment of the Indian Government. Failure on a gigantic scale, more especially when carried out at great expense, and with disastrous consequences to the country, is regrettable, but to the initiated there is nothing disheartening in failure when it is known to be the direct result of disregard of the elementary principles which govern all human undertakings. The drowning of a thousand men who could not swim in the effort to cross a river is in no way a proof that one good swimmer would not cross it with the greatest ease and without the slightest fear of the consequences.[1]

The important questions arise—What class of men should be employed to form the Agriculture Department in India? How many are required? And where shall we

[1] The foregoing portion of this chapter is taken, with some few verbal alterations, from the Introductory Lecture by the Author to the Agriculture Class in the University of Edinburgh, delivered in October 1887.

go to find them? There never was at any previous period a better opportunity of supplying this prospective demand from the ranks of the hereditary farmers.

The men suitable for the purpose are well-educated sons of gentlemen farmers, brought up in the country and accustomed to mix freely with the lower classes, so that they are more able to understand and sympathize with them than the sons of men in the higher spheres of life, who have never been really in touch with individuals far beneath them in rank.

Young farmers with a good general education, and who have been trained from their youth in those details of agricultural practice which can only be acquired by early association with a farm and its purtenances, have within recent years been induced to undertake scientific study and research, in many instances with the object of becoming land-agents, and in other cases so that they might be more able to contend with the increasing complications of the times, which have often proved too much for the old-fashioned farmers working according to old lights.

To make certain that the best men available in all parts of the country are secured, some such arrangement as the following might be adopted :—

(1.) There should be a minimum test and competitive examination in the subjects of (*a*) English,[1] and (*b*) Agriculture. The latter to be made so thoroughly practical that no one could pass who had gained his knowledge and experience solely from books.

(2.) The educational qualification, which it should be imperative for a man to possess before going forward for the final examination, should be a Degree in Agriculture, or the Diploma of one of the leading Societies or Associations offering such in Agriculture and the collateral sciences.

By this system the best candidates could be secured, and much expense in examining would be saved, as com-

[1] The ordinary subjects of an English education, but excluding Literature.

pared with conducting special examinations in all the subjects required for the qualifications mentioned.

The Examiners in Agriculture should be the Professors of Agriculture at the four main centres of agricultural training—Edinburgh, Dublin, Cirencester, and Downton—two to act each year, taking their places in rotation. The appointment of these examiners would have many conspicuous advantages. The men possessing the greatest amount of experience in the special work would be selected, and the interests of all the teaching centres safeguarded and stimulated.

In this connexion it seems appropriate to clear up misapprehensions regarding the exact position of those whose whole scientific and practical training has been gained while passing through the usual agricultural college curriculum, extending over two years and a few months. This should be of special interest to India, as I may say the so-called "Cirencester graduates," whether Indian or European, belong to this class. The idea that any man, however able, can gain a thorough knowledge of the science and practice of agriculture in little more than two years is a delusion of the most patent kind. I wish to make it abundantly evident that in what I say I mean in no way to disparage the excellent work, so far as it goes, which is done at the Cirencester and Downton Colleges. I have the highest appreciation of the results which, I am aware from personal knowledge, are largely due to the present able staffs of teachers.

All that a college diploma shows, is that a student has, with considerable advantage to himself, passed through a course of scientific training in subjects allied to agriculture; that he has attended about 100 lectures on the scientific principles and practices of agriculture; that he has, to a greater or less degree, seen and had explained to him the field operations of a farm; and also that he has visited places where various descriptions of stock are bred, and has been told how these are treated. But there is no diploma in the United Kingdom which is a guarantee that a man is capable of managing any branch of agriculture, either for himself or any one else. Without some years of actual practical training after, or partly before, the scientific course, I can from intimate personal knowledge of the facts attest, that men are not qualified to direct the operations of a farm without blundering. They are not agricultural chemists, botanists, or veterinary surgeons; but they are most capable of beginning to learn actual farm work and management,—able to understand what comes before them, and to find out scientific reasons for successes or failures in practice. They have received a sound general training in the elements of the most useful sciences entering into the practices of everyday life on a farm. It must be clearly evident from the foregoing remarks, that it was in vain to hope, as some imagined, that the Cirencester graduates, on their return to India, would be qualified to begin to teach the natives better systems of agriculture than their own. They were qualified to do no such thing. They should have been sent out into the districts to make themselves thoroughly conversant with native agricultural practices, to find out from the cultivators the reasons why each operation was performed in a particular fashion; and where this could not be done, to discover, by the light of their superior scientific knowledge, either a reason for the continuance of the practice, or a good and sufficient reason—based on fact, not conjecture or hearsay, but arrived at by means of a profound knowledge of detail —why they should be discontinued. Only in this way could the considerable sums of money spent on scholarships, given by the Indian Government throughout a period of some five or six years, have been made use of. With but few exceptions, the men who came to study agriculture in England have not been employed in agricultural pursuits at all, and it goes without saying that the expenditure incurred in their education had been spent in vain.

But to return to our typical member of the Indian Department of Agriculture who has been selected through the test of a sufficiently searching examination from the ranks of the hereditary farmers in this country. He goes out to India, perhaps, at the age of 22 or 23 years. I intentionally add a few extra years over and above the usual age, during which period time would be allowed to perfect his knowledge of British agriculture. I consider the acquisition of this is most essential, because, for purposes of comparison,—which ought to be one of the initial steps adopted in the plan for the improvement of anything,—there must be some standard by which to contrast the institutions or practices under observation or review. If an individual does not possess such a standard, he must manufacture or imagine it in his own mind, and the chances of his selecting a wrong one are very many against the single chance of his choice being right.

About two or three such men in each Presidency would be sufficient for the purpose to begin with. The first three years should be entirely spent living among the people, learning their language, customs, and farm practices. During that time these young officers might with advantage move from one district to another, and take notes for their own future use.

In the interests of the service, but none the less in the interests of themselves and their future wives, **their salaries** should be small at first, to deter them from marrying. I feel it is quite unnecessary to enlarge upon this matter either by way of explanation or apology. The salaries should, however, rise to a good sum in the end, and there should be attached a suitable retiring pension. To begin with Rs. 250 per mensem would be sufficient, with the usual travelling and tentage allowances, during at least the first three years devoted exclusively to acquiring a knowledge of the native people and their languages.

The sum should rise by suitable increments to Rs. 800, towards the end of a period of thirty years' service. Finally, the pension given after that time should not be less than £400 a year. With an arrangement of this kind, I believe that better men for the work would be got than if double the amount of money were offered in salaries.

The objection advanced against my proposal, by those accustomed to the rate at which most things are done in India, is that it would take too much time; that Government could not afford to wait three years for results, and then at the end be unable to lay their hands upon them; that there would be nothing to show of a practical kind that could be either looked at or printed in a Government blue-book, except the hope that the time had been well spent, and that the future would benefit by the sacrifices of the past. Government might as well issue an edict that in the future the wheat crop shall be ripe at the age of four months in place of six months, as attempt to train agricultural officers in a period too brief for them to master the details of the subject. To unduly shorten the time necessary to be devoted to a special branch of learning not only curtails the usefulness of the learner, but, if he is to be a teacher, is productive of evil, in that he is permitted to impart a knowledge which is spurious and imperfect.

After three years the young officer should spend two-thirds to three-fourths of his time touring in the districts among the people, and while there daily take notes. These notes should be most carefully and systematically condensed, and published as an annual report. Notes about such matters as are at the time of publication not fully worked out should merely be mentioned, and the details kept over to be added to and revised during the succeeding season. Each officer's report should be read and reviewed by the other members of the "learning department" working in different districts. Thus in groups of districts points of disagreement in fact and opinion would annually be recorded. A systematic index of these reports would enable any one interested in a particular subject to lay his hand, at a few minutes' notice, upon the whole literature bearing upon it. In a very few years valuable records would be made, not only of the methods of cultivation, but of the reasons for them. And with a thorough knowledge of what exists in the first instance, what ought to be, and the way to bring it about, might be arrived at.

Reports compiled by men who have not a thorough knowledge of the subject, however well intentioned, and however elaborate (which is often a prominent point of weakness), are not only worthless, but injuriously misleading, more especially as regards the conclusions drawn from results. The time is past, if indeed it ever existed, when a casual report of a man well employed with other matters could be of any service to agriculture; and the time has unquestionably arrived when nothing but a well-trained specialist has any right to endeavour to influence the destinies of the world of Ceres.

Text-books, which are so much wanted before anything substantial or extensive can be accomplished in the matter of teaching agriculture to the natives, can only be compiled from material collected in the way I have indicated. Anything or everything from whatever source is not good enough to put into a text-book. Let me remind the reader of a fact which ought to be taken as a truism quite as applicable to agriculture as to other branches of business, that spurious teaching is not only negatively good, but positively bad if it were for no other reason than this, that, in virtue of it, future efforts must naturally be discredited.

It is my firm conviction that it is practically of no good to attempt to teach agriculture until text-books and trained teachers have been secured. This must of necessity be a work of time. The development of agriculture—and we must look at the teaching of it as one of its many branches—must, if it is to keep in the proper grooves, come about slowly. There is safety in this fact, and a commencement is made possible and feasible by its being inexpensive.

The study of agriculture need not necessarily be confined to men who are ultimately intending to join the Agriculture Department. So many branches of the Government service are more or less associated with land details, that it appears Fuller's idea of making agriculture an optional subject of the University preliminary examinations for a degree is an excellent one. I believe such a course would be justifiable if it were only to enable clerks, and even higher officials, to express themselves in correct technical agricultural phraseology.

I think it may be taken for granted that it is only possible to teach the great mass of the people by native instructors. If a number of agricultural schools and colleges were equipped they would get the ground-work of their scientific training in these places. For practical training they might be allowed to find room on Government experimental farms, or on estates under the management of the Courts of Wards —where such exist. I wish it to be distinctly understood that they should in no way be a charge or burden on these estates. A few of the best men might be sent to the United Kingdom for a year to study British agriculture at a very moderate cost. The system of training would differ from what has been adopted in the past in this, that the main part of the student's scientific course, as well as the elementary part of the subject of agriculture and the early part of his practical training, would be undertaken in India. It would extend over a longer period, and would consequently be more thorough; and it would be less expensive. The year's experiences in this country, under the circumstances, would be much more useful than two years were formerly, because built on a broad and well-laid foundation of science explained by the light of native practices. The selection from the candidates offering themselves to come to this country being grounded on a practical as well as a general education basis would secure an excellent class of men for the purpose.

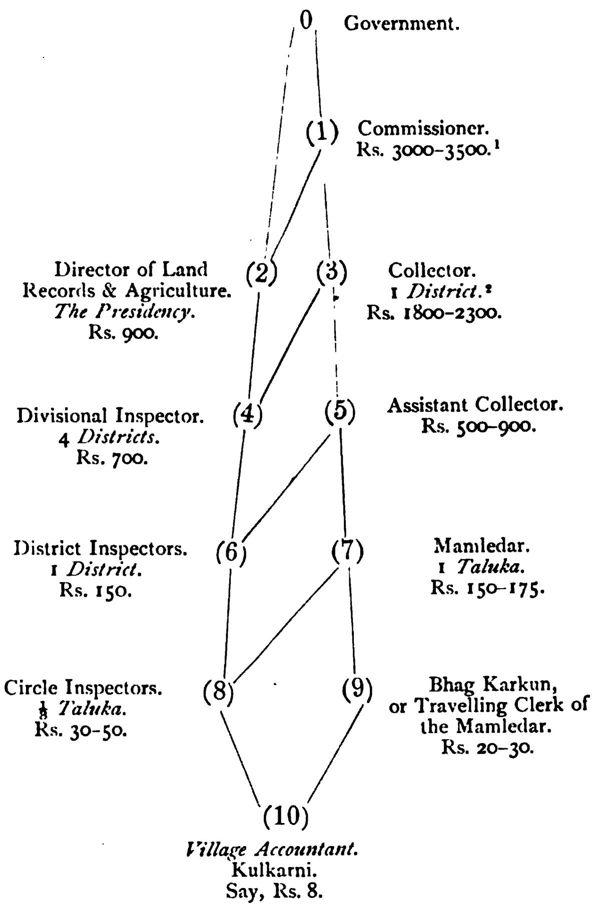
From a higher standpoint,—that of moral and social, not to speak of religious, influence,—the proposed system of sending carefully selected natives to this country would, if they were put under well-considered regulations while they remained in the United Kingdom, have an influence for good on the future of India. This influence would be widely spread in virtue of the fact, that those exercising it would come to be, in pursuit of their occupation as Government officers, distributed throughout the Empire.

As one educated and intelligent Brahmin judge tersely expressed the position to me, "You need not expect that we can ever agree to give up what we consider sacred in our domestic life for a system of social order like yours so long as we have no better interpretation of it than the frequent reports of evidence given in your divorce courts!" Unfortunately for us, as well as for our influence abroad, it is the weak parts and not the beauties of our social system that are thrust most prominently before the notice of the observant foreigner, through the clamour of a degenerate section of the public for news of a low-toned and exciting character.

One of the duties of the Famine Commission was to inquire into the condition of native agriculture, and recommend means for its improvement. One of its strongest recommendations was the equipment of an Agriculture Department. This has been given effect to in name by the establishment, in 1883, of the Department of Land Records and Agriculture, but money has not been forthcoming to develop the work of the department relating to agriculture, and no doubt mainly on this account, with few exceptions, officers suitably trained for the work have not been secured.

As the Bombay Presidency affords for the moment the best developed example of a departmental scheme, I propose to explain this somewhat in detail. For simplicity I show on the following figure, after a sketch given to me by W. P. Symonds, C.S., the relative positions of the Revenue

Land and Statistics. *Revenue Department.*



[1] The pay of officers is stated in Rs. per mensem.

[2] A District is the charge of the Collector and Magistrate, and may be likened to a county in England, though larger on the average.

Department and of that of Agriculture, or, more correctly, Land and Statistics—the former, marked by odd numbers, on the right, and the latter, marked by even numbers, on the left. Both sides meet in Government, and both begin with the village accountant, the lowest paid official. It will be noticed that the Director is partly under Government directly and partly subordinated to the Commissioner, and so each lower grade of the Department of Land Records and Agriculture is subordinated on the one hand to the next superior grade in the Agricultural Department, as well as to the corresponding grade of the Revenue Department. The Circle Inspectors are subordinated to the Mamledar, but their work is supervised and guided by the District Inspector and his assistant.

The arrangement described is that which is gradually to succeed the expiring Bombay Survey Department, as its work is finished. Only two districts, Dharwar and Bijapur, have as yet fallen in, and it is proposed to make use of a few of the European Survey officers to fill the posts of Divisional Inspectors in the new department; the Survey subordinates will similarly also largely fill the ranks of Circle Inspectors. Now, each of these districts has forty Circle Inspectors, and one District Inspector and an assistant on Rs. 60 per mensem.

In each village there is a Patel or head man, generally hereditary, besides the Accountant, who may be hereditary or stipendiary. These make up the village accounts—revenue and police, and register crop-areas, census, and general statistics. Hereditary accountants have usually very small salaries, but generally hold rent-free land.

The Mamledars are well-paid and educated native officers, who hold magisterial powers in addition to the duties of supervising revenue work. They collect the revenue, and give information to Government regarding any matter connected with the district.

The Agriculture Department has to keep up the

Revenue Survey Record; inspect boundary marks, which were erected by the Revenue Survey Department; and test crop and other statistics registered by the Revenue Department. This latter is performed by the circle inspectors, who also test the crop estimates each year, and when necessary do a little survey work, as dividing fields for ryots at their request, and for which they pay. [Any survey divisions or boundaries made by the direction of Government are free.] The inspectors are in addition supposed to collect information relating to the management of and the kinds of crops grown—in short, to compile general agricultural facts into statistical reports.

These men have no previous agricultural training, with the exception of a few who come from the College of Science, Poona. They are overlooked by district inspectors, who are better educated, but not in agriculture! It follows that in the collection of the general agricultural statistics these officers, who are not able of themselves to understand agriculture, must go to the patels or ryots for their information. This is where the system as it now stands breaks down. A man who is ignorant of agriculture cannot frame questions so as to elicit information which would be of use to an agriculturist. He does not know what to ask, and is not capable of understanding the direct and lateral bearings of good answers when they are forthcoming. Even if the officers had the information, they could not, without knowing the most common agricultural phraseology, express themselves so as to be intelligible to an agricultural community; and, besides, information however valuable passing through the hands of a number of men unable to judge personally of the facts of the case, gets contorted into forms which leave little resemblance to the originals. If general information regarding agriculture is to be collected and to be of any value whatever, it must be accurate and of such a kind as is required by agriculturists. That can only be collected by men thoroughly trained in the work. If not so compiled, it will be misleading. Misstatements and all sorts of valueless matter will be recorded at Government expense.

All native officers who are in future taken into important and responsible posts in the Agriculture Department should have a Degree in Agriculture, which might most advantageously be offered by such institutions as the College of Science, Poona, on similar terms to those laid down by Principal Cooke and E. C. Ozanne in a paper dated 8th March 1886. No organization of a department can be considered satisfactory which does not provide for the employment of the Government scholars from Cirencester, upon the education of whom the State has already spent large sums of money.

I grant that in establishing a new department it may be necessary (as was the case with the Forest Department) to fill appointments with men who have not been specially trained, when certain officers who have some experience in *part* of the work are free and have to be provided for, and when no specially trained men are available; but it becomes a perfect farce if a department is formed with the understanding that responsible and important posts are to continue to be filled by men who have no real experience of their duties. When it is a matter of writing reports in an office, one smart man may be as good as another; but when it comes to practical work in the field, the man must know something of his business if he is to do his country service.

The absence of a thoroughly equipped Agriculture Department naturally induces officers in other departments to advise Government in a confident and authoritative manner, as if they were all trained agricultural experts, and really qualified to give an opinion on this purely technical subject, which requires through a period of years the entire time and energy of those brought up with the hereditary instincts of the profession to enable them to become proficient in it. Those who rest so much confidence on the hereditary knowledge and instincts of the native cultivator will, if expressing an opinion on an agricultural matter, do well to remember that their own knowledge of the subject is not associated with this quality, which is so highly prized in the native. In short, test their fitness to speak on the subject by applying to their knowledge of it a standard of their own selection. The position of such a one may be likened to a farmer who thinks he is an authority great enough to be a critic of military tactics and the movements of troops under arms, because he has ploughed for years in a field adjoining a military parade-ground, and seen with his own eyes *everything* that has been done. The respective gentlemen all the while are busily occupied with their own work; but such proficients are they at that work, that they succeed meanwhile in learning all about other work in which their own special knowledge is no guide.

Further, our self-constituted agricultural expert has only seen one or two, or at most a few districts of India, a country which is so vast and so various, yet he gives his opinion as applicable to the whole.

In the same way, and on equally good grounds, our warlike farmer, who has only seen troops on the one parade-ground, believes himself quite competent to plan the order of march of the British army to Cabul. [Apropos of this, I feel quite confident that many men who express opinions on agricultural matters when they have no right to do so, are so totally ignorant of the facts before them that they honestly believe there is nothing more to learn or to know.] To complete our simile: The only point where the parallel breaks down is that the opinion of the farmer, from his insignificant position, is not listened to; whereas the other, from his personal influence, his wide acquaintanceship with those in authority, and his plausible method of stating his case, may very possibly mislead the unwary into belief in his views. It is astonishing how easily plausibility is mistaken by the uninitiated for profound knowledge.

It is quite natural that other departments should oppose the development of an Agriculture Department, because the money necessary for its support would have to be saved from the worst spent money of those departments.

As regards the necessity for skilled advice in things pertaining to agriculture, it is merely a matter of common sense, which can be arrived at by comparison with some thing which one has an intimate knowledge of. Let the position be reversed. Let the engineer, as a man who knows his profession, estimate in his own mind an agriculturist's opinion of some great engineering work. Ask the soldier to follow the advice of a farmer in some great question of military tactics; the lawyer to consult a farmer friend as to a knotty point of law in a great case in which his reputation is at stake; or the doctor to sink his views as to the treatment of disease in favour of a man who follows the plough. The reply in each and every case would be,—"Such a course would be ruinous, and inevitable disaster and ridicule certain." As an agriculturist, I am prepared to risk my reputation on the statement, that the opinion of a professional man on an agricultural question is not one whit more valuable than would be the opinion of a farmer on a scientific or technical matter of which he is totally ignorant. Agriculture is so extraordinarily diversified, even within its main subdivisions, that it demands a longer apprenticeship than any other art one could name, and it demands further that that apprenticeship shall be begun early in the life of its votary. A man may in a short space of time be able to recognise that certain customs or practices are not perfect, but it takes much experience to be able to give advice in the matter of a remedy. To think otherwise is pandering to that weakness of human nature, which, according to one of our late great literary divines, induces people to imagine that the details of any business except *their own* can be managed by common sense without experience. The idea that sound agricultural knowledge can be picked up even by men of the greatest ability while their time is occupied with the full charge of some other department of the public service will not now bear the light of day. "A little knowledge is a dangerous thing," and by those who are qualified to judge of the value of a little irresponsible agricultural knowledge, especially in the possession of those occupying important positions, the unanimous verdict has been, and will continue to be, that in things agricultural a little knowledge is more than usually dangerous. A man with a smattering of agricultural facts and figures is like a beginner at the game of chess, but nevertheless one who *knows all the moves* perfectly.

I have known the juvenile chess-player not only believe, but assert it with confidence, that he played a better game than his old and experienced opponent, had it not been for the various *slips* and *oversights* he made, for which, of course, he could not blame his *knowledge* of the game; while, in short, so little did he know of it that he fancied, after he had learned the moves, he possessed a perfect knowledge of one of the most intricate, though at the same time one of the most enjoyable, games in which the members of educated and intellectual societies indulge.

In the same way the amateur agriculturist never dreams of blaming himself for the blunders he commits, but saddles the circumstances or his bad luck with the failure.

The same chess-men in experienced hands would often win the game when they would lose it under other guidance. It is exactly the same with agriculture. Skilful guiding, under given circumstances, would often score a grand success, when want of skill, with exactly the same circumstances, could only end in ignominious and complete failure.

The enthusiasm of an individual and his love of rural life often lead him to form a greatly exaggerated estimate of the profundity of his agricultural experiences, and not infrequently mislead those who are not practically conversant with the matter ; but no amount of devotion to the subject will, without experience, command success in agriculture any more than will the greatest and repeated efforts of the inexperienced chess-player overcome the well-laid plans of an accomplished and veteran opponent. There is the least possible element of luck in chess, and there is no such thing as a man being born under a lucky agricultural star, or finding a royal road to a knowledge of either the science or the practice of agriculture.

I have indicated by the way many circumstances wherein an Agricultural Department would prove of value to the country, but there yet remain a few points which deserve special mention.

Experiment is a means by which the new department would become master of the situation, and by which ultimately it would be able to benefit the community. One of the most prominent mistakes in the past has been the effort to persuade native cultivators to adopt certain new practices before these had been first carefully tested to find whether they were really suitable to existing conditions. The distrust which natives show in this matter is mainly due to this regrettable fact, the result of the carrying out of proposals which have so often ended in failure. Another fatal blunder from which India is in no way exempt is the undue haste to arrive at results when experiments are set in motion. Ordinary agricultural experiments, to be of national value, must be continued through a series of perhaps ten years, to eliminate all exceptional conditions of soil and climate, and sundry anomalous accidents.[1]

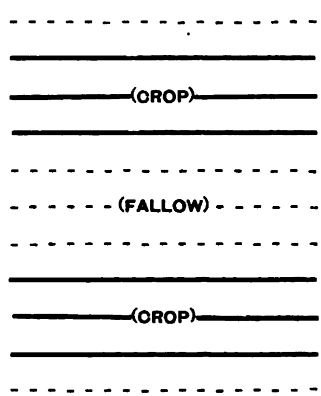
[1] Sir John Lawes, the veteran European experimenter, in his recent contribution to the *Journal of the Royal Agricultural Society of England* (1888), says :—" The influence of climate upon our crops is so vast, and the fluctua-

In our own country there is no better example of what I assert as to unchecked results being misleading and injurious than that of the Aberdeenshire experiments. All the more important results recorded without sufficient experience in the early reports have had to be given up as fallacious.

One of the difficulties in the way of carrying out experiments in India is the liability of the results to be vitiated by **pilfering** from the standing grain as it comes near to maturity. A six-rowed barbed wire fence would be an effectual barrier to all intruders except hares and rabbits, both of which I frequently saw. These could easily be excluded in the ordinary way by wire-netting.

E. C. Ozanne had a series of most useful experiments going on at the Khándesh Farm.

I was particularly interested in his *Lois Weedon* plots growing wheat year after year on the same area, though not exactly in the identical part of the soil. The crop was sown in groups of three rows, 12 inches apart, with intervening spaces of fallow land. The land which is under crop the first year is fallow next year, and *vice versa*. The advantages are that the crop has the benefit of the whole air space, while the land has a rest every alternate year. I believe it



Lois Weedon Plots.

tion in the season so great, that any conclusion drawn from the produce of one or two years is very apt to be misleading. Although the average climate of any ten years is not necessarily the exact counterpart of the preceding or succeeding ten years, still we may safely make use of the figures obtained from a ten years' average to bring out several very important agricultural facts, provided that the original arrangement of the experiments has not been subject to any serious alteration."

is possible that this system may have a great future in India.

D. B. Allen did good service by organizing a well-arranged set of experiments at Dumraon, the expense of conducting them being defrayed by the Maharaja.

I had the pleasure of taking part along with Allen in the laying out of another most complete set of twenty plots for experimental work on the estate of the Raja of Naldanga.[1] Each plot was one-sixth of an acre, or one-half a standard Bigha. An Agricultural Department would supply the technical knowledge necessary to start such stations throughout the country.

Agricultural shows[2] of stock and produce, which undoubtedly extend information and awaken a commendable interest in the minds of the working classes of all countries where they are held, could be organized by the Agricultural Department. It struck me that the more thoroughly native the management of details could be made the greater would be the resulting benefits. The department could, after stimulating and encouraging those who possess the

[1] Raja Pramathabhushana Deva Raya had been educated at the Court of Wards Institution, Calcutta. I was much struck with the extraordinary amount of energy and ability this young nobleman possessed, and the never-ceasing efforts he made to improve the condition of his people. His mansion-house and all its appurtenances were designed by himself; and not only this, but even the bricks and mortar were made by his own servants, who had got their only training from him. He also taught them to shoe horses and train refractory elephants. He bred, reared, and broke his own horses, and he possessed some very fine ones. He was his own veterinary surgeon. He was a sportsman of no mean order; and to prevent the ridiculous extortion of the Calcutta furriers for dressing the skins of his large game, he had them beautifully tanned at home. His rooms were decorated with a profusion of skins of leopards and panthers. Altogether I was impressed with the fact that the young Raja, with whom I spent two days, could teach the majority of young Englishmen in his own sphere of life a wholesome lesson in originality of idea and execution of purpose.

[2] The good which shows are capable of doing may be seen by referring to Rickett's evidence in the *Report of the Famine Commission*, vol. ii., Appendix iii., page 201.

capacity, indicate the main lines, and show the direction in which to move, and then leave the execution to the people themselves.

For example, in the Patna Division there are five Maharajas, besides Rajas and Nawabs or Mohammedan chiefs.

Each Maharaja might easily be in turn induced by Government to carry out, as has been done by the Maharaja of Dumraon, the arrangements for a show, and bear the expense of it. The rivalry which would arise as to who should make the arrangements most complete would guarantee the success of the shows. They would be held at a different centre each year, so that all those interested would have a share of the convenience connected with proximity of situation. The show coming round to each Maharaja only once in five years would not prove a serious drain upon the exchequers of those supporting it.

As a reward of excellence in all matters relating to agriculture, I believe it would be most useful to institute an *honorary distinction*, which should be in two grades, a lower and a higher: the latter only to be given to men who gratuitously do for the State really good service. Rewards of this kind would create a wonderful amount of rivalry and interest in the staple industry of the country, and would cost Government nothing.

There is sufficient scope for the development of local effort and local interest in India, and if it were set about in a judicious fashion, there would be found a vast amount of suitable material to operate upon. **One of the chief functions** of an Agriculture Department would be that of **organization.** This would at times amply suffice to command success, but material support might also be necessary in other cases. **A good example** of the latter appears to me in a proposal which D. B. Allen made regarding the improvement of cattle. He told me that it would be possible for Government to start a number of small breeding centres for cattle of superior quality among the zamindars and indigo planters in Behar, by placing in the care of a number of men who were, according to his personal knowledge, agreeable, a small herd of say 20 or 30 heifers accompanied by a good bull. The cost to Government would be perhaps Rs. 1000 in each instance. The original stock and also the heifer calves would remain the property of Government, the male calves going to defray expenses and yield profit or remuneration for the trouble of management. In this way, at a small cost, good cattle could be distributed through many parts of the country. This proposal involves simply an extension of a common practice in India. The owner of a cow frequently lets it out or makes it over to a cow-herd, who pays all expenses and shares the profit on the calf with the original owner. The way is clear, and it only wants a department with the necessary knowledge to carry the suggestions into effect.

Efforts to introduce new crops by the distribution of seeds have been made from time to time in a sort of desultory way, and in some parts with success. In the work of an Agriculture Department this branch holds out well-grounded hopes of extensive and substantial improvement, but it is work which demands special experience, and can only be successfully carried out in conjunction with experimental stations, either belonging to Government or enterprising natives. There are two fields of operation, which would directly come under this branch of the Department, which are absolutely untrodden in India, and which, I believe, will ultimately become valuable—(1), the improvement of crops by the selection of the best developed seeds, as has been so successfully practised by Hallett in the case of nearly all our common grains; and (2), the hybridizing of such a crop as wheat by the method followed by Carter & Co., High Holborn. By these practices the size and quality of the grain can be wonderfully enlarged and the yield of crop increased. One conspicuous advantage is that by these means in a given region the common grain, which had already proved itself to be suitable to prevailing local conditions, could be operated upon, and all risk of failure, which has so often attended the importation of external varieties, done away with.

The Agriculture Department should also be the department made responsible for supplying to officers in charge of irrigation works the information necessary for the proper distribution of the available water supply. I read in the *Report of the Famine Commission*, Appendix V., page 112, par. 5—"Even in the most recent irrigation systems of Madras the Public Works officers, who have entire control of the water, have no accurate information supplied to them regularly and at the proper time, of the area they irrigate." Is it to be wondered at, under these circumstances, that we do hear of land lowered in fertility by an over-abundant supply of irrigation water, while at possibly another part of the same water-carrying system the crops are being ruined for want of water, and a bill for damages is being prepared for Government in consequence?

If what I have said, from a technical point of view, is not sufficient to convince every one of the reasonableness of the proposal to establish and fully equip a special department worthy of the great interest of agriculture, the following references to authorities in the matter should demonstrate in the clearest possible way the necessity for such a department.

The Government of the late LORD MAYO, in a minute dated the 6th of April 1870, recommended to the Secretary of State for India the establishment of a Department of Agriculture and Commerce. The following extract embodies the ideas of the Government on the subject:—"Of all branches of Indian industry, agriculture, which constitutes the occupation of the great mass of the people, is by far the most important. We believe it to be susceptible of almost indefinite improvement. It is not necessary to dwell upon the obvious and vital necessity of increasing, in every practicable way, the supply of food available for the people of India. How this consideration affects all the prospects of the permanent material advancement of the country has, of late years, been painfully and repeatedly shown by the late famines which have taken place, and to the recurrence of which we shall ever be liable until the production of cereals is rendered more certain, and the facilities of conveyance immensely developed. For many generations to come the progress of India in wealth and in civilisation must be directly dependent on her progress in agriculture. In India agricultural and commercial progress go together. Agricultural products must long continue to constitute the most important part of our exports; and the future development of Indian commerce will mainly depend on the improvement in the quantity and quality of existing agricultural staples, or on the introduction of new products which shall serve as materials for manufacture and for use in the industrial arts. . . . .

"It cannot be denied that Indian agriculture is in a primitive and backward condition, and we think that it must be admitted that the Government has not done for its improvement all that it might have done.

"To state exactly what measures the Government ought to have taken in the past, or what course it should follow in the future, is undoubtedly not easy. It is hardly too much to say, that scientific knowledge of agriculture in India has at present no existence. The common belief has been that the natives of this country can, in respect of the processes of agriculture, derive little or no benefit from any instruction which European science can give them. Such a belief rests, perhaps, upon observation of the obvious progress which has been made in many of the elementary requirements of agriculture in regard to tillage, rotation of crops, and so forth! But it has often been lost sight of that this sort of knowledge is only rudimentary and empirical, and that recent experience in all parts of the civilized world shows conclusively that there is no branch of industry in which the effects produced by the intelligent application of science are more certain or more remarkable. We cannot doubt that when the light of science has been properly brought to bear upon Indian agricultural experience, the results will be as great as they have been in Europe. . . . .

"In their well-known despatch of the 19th July 1854, on the subject of Education in India, the Court of Directors referred with approval to proposals that had been made for teaching practical agriculture. Quoting the words of Dr Mouat, they said that there was no single advantage that could be afforded to the vast rural population of India that would equal the introduction of an improved system of agriculture. Unfortunately, the means of obtaining agricultural instruction are no better now than when the despatch was written fifteen years ago. We do not disguise from ourselves the difficulty of affording to Indian landlords and cultivators the means of obtaining scientific and practical knowledge for the improvement of agriculture. But the difficulty of the work ought not to discourage Government from doing everything in its power to develop this important branch of education."

The facts are practically the same at this moment as they were eighteen years ago when the above quoted official opinion was expressed. There is, however, one conspicuous difference as regards the likelihood of the suggestions being now carried out as compared with the chances of their assuming practical form in 1870. The repeated failures of attempts to *alter* Indian systems of working (I intentionally refrain from saying to "improve," because, had they really been improvements, no doubt they would have been gladly accepted) have shaken the confidence of those in authority in the possibility of the Government doing anything to spread a knowledge of science among the people.

The Report of the Indian Famine Commission,—one of the most able and most elaborate ever written in any country or on any subject,—Part II., under "Measures of Protection and Prevention of Famine," says, at page 139, "Our report has clearly shown how greatly agriculture preponderates over all other interests and employments in which the people of India are engaged; how essential we think it that technical agricultural knowledge should be called in to enable the productive powers of the soil to be applied in the most effective manner, not merely to add to the wealth of the country, but to secure a food supply which shall keep pace with the increase of population; and how valuable in all departments of administration would be the acquisition by the executive officials of more accurate knowledge of the statistics of agriculture, of the ordinary out-turn of the harvests, and the relative produce of the crops from year to year. . . . . It is our hope that an Agricultural Department may be established in every province."

Some valuable information and testimony relating to the necessity for establishing a Department of Agriculture are contained in *Suggestions for Improving Indian Agriculture*, by my friend Lieutenant-Colonel P. Dods, late Inspector-General of Education in the Central Provinces of India. Writing in 1875, he says, "It may be assumed that at the present time very little knowledge of practical agriculture is at the disposal of the Indian Government. Those civil officers who pass much of their time among the rural population know little of the various systems of husbandry; they have more important duties to attend to. Some, indeed, especially the officers employed in survey and settlement work, are exceptions to this rule, but, taken as a body, civil officers know little of agriculture; with ordinary district work to occupy them, they have no time to undertake agricultural experiments, which require several years of close and careful observation."

I wish to add, with regard to the scheme proposed by Colonel Dods for the development of an Agriculture Department, and for the spreading of agricultural education throughout India, that it is practically on the same lines as the proposals which I have made, and which occurred to me during my residence in the country. Though my views are supported by the high authorities previously referred to, I feel I am additionally fortified by finding myself in harmony with one who has had such a large and varied experience of India, more especially in matters relating to education, which must be so fundamentally associated with the development and usefulness of any Agriculture Department.

CONCLUSION.

It has been repeatedly said, "We grant that your proposals seem all right and proper, but *where is the money to come from?*" My answer to this is most simple—Provide for the necessary expenditure by diminishing grants to and cutting down the expenses of other departments. I have pointed out that even education, as now given, is not an unmixed advantage; that we are actually, without calculating the cost and without using the available means open to us to avoid them, raising difficulties that did not before exist. If we have not arrived at it, we must be nearing the time when thinking people will admit that it is much more important for a government to attend to the wants of a community as regards their supply of food, than to spend the money which might be used to guarantee immunity from famine, with all its concomitant baneful and demoralizing influences, upon higher and secondary education, which, after all, is only taken advantage of by a limited number. Again, it would be most salutary to *Churchill* the Public Works Department in the matter of a given day being arbitrarily fixed for the completion of the expenditure of each grant given towards the work carried on by the Department. I feel confident that from what I heard of the working and influence of the system, not only in one or two quarters, but throughout India, much of the money required could be got from saving effected by this means. I have no doubt I shall be told I am trespassing on ground where I have no right to enter, but I claim as an agriculturist to have an intimate personal knowledge of much of the class of work which is under discussion; and further, from many years of the closest possible intercourse with the labouring classes, I have had exceptional opportunities of knowing what unavoidably must be the evil influences which attend the present system. The doings of the Public Works Department have been fruitful of the greatest blessings to India. It may well be said that but for the Public Works Department the material progress of India would have been comparatively at a standstill. The opening up of the country by railways, and many local and minor blessings, have emanated from this Department. So great, in short, has been the good flowing from it, and so powerful the influence wielded by it, that some have been forced to believe that its every detail is perfect, and that to attempt to advocate any sort of reform must be sacrilege of the worst kind. In spite of all its admitted greatness and goodness, I venture to assure my readers that it has one stain on its fair fame. By one error in its constitution, it wastefully and needlessly swallows up much of the patrimony which should by right fall to an Agriculture Department. According to the last statistical returns, the expenditure of the Department for 1886 amounted to over 226 millions of rupees, about one-fourth of which was spent in England or lost on exchange. The works are carried out on special and detailed fixed grants, and each grant is made for the current year, which ends on 31st March. Should the money not be all spent within the year, what remains of it lapses to the Treasury, and is considered to be lost to the Department. This is so whether the work for which the grant was at first given is finished or unfinished. If the latter, a new grant has to be secured before the work can go on. If the money which could not be conveniently and economically spent were allowed to revert to the public purse, I should not have a word to say; but the abuse against which I protest arises from the extravagant and wasteful expenditure which is incurred as the end of the financial year approaches.

By way of illustration, I shall suppose a case where a grant of Rs. 10,000 is given for a certain work, which is begun at the end of July. Four months of the year are gone, so that only eight months remain in which to do the work. The natural rate at which the money can be spent with economy and to the best advantage is Rs. 1000 per month. This goes on steadily till the end of seven months, when the officer in charge is reminded from head-quarters that Rs. 3000 of the grant remain, and must, if possible, be spent within the remaining month. If the officer is a "strong" man from an official point of view, and is prepared to adhere to what he knows to be the country's best interests, he simply, in the most courteous terms, replies to the effect that he cannot see his way to spend the money, and the matter ends with Rs. 2000 being left over to be returned to the Exchequer. A "weak" man dare not attempt this course. He finds it to be to his interest to set at once to work to treble his expenditure, by adding inexperienced and inferior hands to his staff, and so on. Wages all round are raised, owing to the sudden and unnatural demand. The money is spent, but it is quite possible the amount of work done during the final month is no more than that of an average taken over the previous months. Not only has there in any case been but a most unsatisfactory addition to the amount of work in proportion to the increased expense, but the new year is ushered in with the whole staff demoralized. Nothing demoralizes labourers more than to see public money deliberately thrown away in the manner indicated. It is needless to imagine that they do not see the mistake. They know it, and take the fullest possible advantage of it.

Doubtless the above system has had no little to do with raising the cost of all labour employed under the Public Works Department considerably, and in many instances very considerably, above the cost of labour employed by others. In raising the cost, the demoralization of which I have spoken would act more in reducing the amount of labour done per man per day than by increased wages.

It is a notorious fact that wherever public works are proceeding the cost of labour is immensely raised—in many cases more than doubled. This does not all arise from increase in the demand for labour, but in my opinion may be largely attributed to the above causes. I believe the remedy is to be found in putting greater faith in the executive engineer, and allowing him time after the year expires to spend the money originally voted to any given work; the money, as regards the public purse, being held as spent. Be this the remedy or no, there is one thing of which I am perfectly assured in my own mind,—that the present condition of things as regards the point referred to is fundamentally wrong in principle, and is doing an incalculable amount of injury. It may be a convenience in the matter of State bookkeeping, but it is unquestionably not business. No private individual, no ordinary company could afford to carry on its work in any such fashion without drifting rapidly into a condition of bankruptcy. If the present tendency in exchange continues, Government will be forced to alter its plans in this respect; and I am only too sorry to have to confess that, if the ideas of bi-metallists are correct, there is no hope for improvement while our currency remains on its present basis, and no reason in the wide world why the rupee should not come down in value to one shilling.

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